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THE FOUNDRY

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Trade Outlook.

In common with the blast furnaces the foundries throughout the country are experiencing more or less difficulty in obtaining a sufficient supply of coke to keep in continuous operation. It is claimed that a lack of transportation facilities rather than an actual scarcity of fuel at the coke ovens is to blame for present conditions. Fancy prices have been paid in several localities for a temporary supply of coke to prevent complete shutdowns of plants.

The demand for small lots of soft foundry iron is most pressing and furnaces are being vainly appealed to to hurry forward shipments which should have been received weeks ago. Most foundrymen fail to take into consideration the fact that the furnaces have been tremendously inconvenienced in one way or another and that it has been impossible for them to maintain their maximum output. Complaints are also being made by both furnace and foundry interests that the quality of coke is below the standard. The continuance of the anthracite strike in the east also tends to disarrange ordinary channels of trade. Coupled with the scarcity of the softer grades of foundry iron the supply of high silicon irons is entirely inadequate to meet the demand.

Although foreign iron is being received in increased quantities this fails to exert any influence on the market. The eastern foundrymen are, after a lapse of many years, again becoming acquainted with English and Scotch brands of iron, and on the whole but little difficulty is found in making up satisfactory mixtures. About two thousand tons of imported iron are arriving daily and more may be expected as the permanency of high prices is established. There has been no cessation in the filing of orders for next year's delivery and it is announced that a majority of the merchant furnaces have secured all the business they can possibly take care of between January and June. The number of these who have withdrawn from the market for this period is being rapidly increased. Not a few large contracts have been placed for deliveries extending throughout 1903.

Nearly every feature of present conditions has a tendency to increase the cost of producing castings, though it is doubtful if full advantage is taken thereof in accepting new orders. As a general rule castings seem to have been advanced only about a quarter of a cent a pound to the consumer during the past twelve-month and it is not necessary to point out that five dollars a ton falls short of covering the increased cost of material and labor. While no great differences exists between employers and employees in the trade at the present time there is an indication that the subject of a nine-hour day is being forced to the front, in fact persistent efforts are being put forth to inaugurate this in some localities.

Small Malleable Plant Wanted.

Hardly a week goes by that we do not receive several letters asking us to tell the writers how they can make steel castings on a small scale or what kind of a cupola they require to produce malleable iron. In our modest way we try to break the news gently to them that the foundry business is somewhat overcrowded at the present time and that there is but little room for the man who expects to

melt iron in a washboiler or a five-gallon lard pail. As a fair sample of these serious inquiries we reproduce the following letter recently received by the Grand Rapids Malleable Iron Co., of Grand Rapids, Mich., asking for prices on a small "malible" plant:

Scottville, Mich., Aug. 7th, 1902.

Grand Rapids Malible Iron Works Dear Sirs i have a Patent invention that requires to be mad of malible Iron & i wish to doe my own manufactoring as i cant find any malible Iron work where i can get any malible Iron casting thay are small castings & i wish to learn what a small malible Iron works would cost that is oven & furnice for making malible Iron & the proses for aneling it you can give me any information i want a plant that will cast 150 or 200 lbs a day Pleas answer by Return mail yours truly. Wm. Tifft.

Another Essay.

It takes the average news gatherer to discover how wonderful a foundry really is. The other day one of these gentlemen gained entrance to the shop of the Kingman Plow Co., at Peoria, Ill., and he immediately took advantage of the occasion and prepared the following description thereof for the "instruction" of his paper's readers, the majority of whom swallowed this as gospel truth:

The grey iron foundry is an interesting place to visit. An immense steel tank, or cupola as it is called, has been erected on one side of the building. Underneath this cupola a fire is kindled and by a hot air blast a great amount of heat is generated. Pigs of iron which come from the blast furnaces of Alabama are put in the cupola and are melted down until the mass is about as thick as syrup. In the meantime the moulders have been making moulds in which the pieces are to be cast. A square, bottomless frame is filled with sand. On top of this sand the brass pattern is placed and pressed very firmly until a perfect impression is made. Over this pattern another frame is placed which is also filled with a moist sand and which also contains a similar impression of the brass pattern. A hole is then drilled through the top of the sand and the frames removed. The mould is now complete and is placed on the floor. When a sufficient number of moulds have been made the molten metal is taken from the furnace and poured into the mould through this hole. In many of the castings made it is necessary to have holes in order that they may be collected by bolt with other castings. To save the trouble and expense of drilling these holes what is known as a "core" is used in the moulding process. These cores are composed of green sand and are shaped similar to small cylinders. The cores are placed inside the mould and after the metal has cooled are easily broken and being removed leave a hole in the casting. After the metal has been poured into the moulds they are left on the floor all night to become thoroughly cooled. In the morning the moulds are knocked apart and the castings removed.

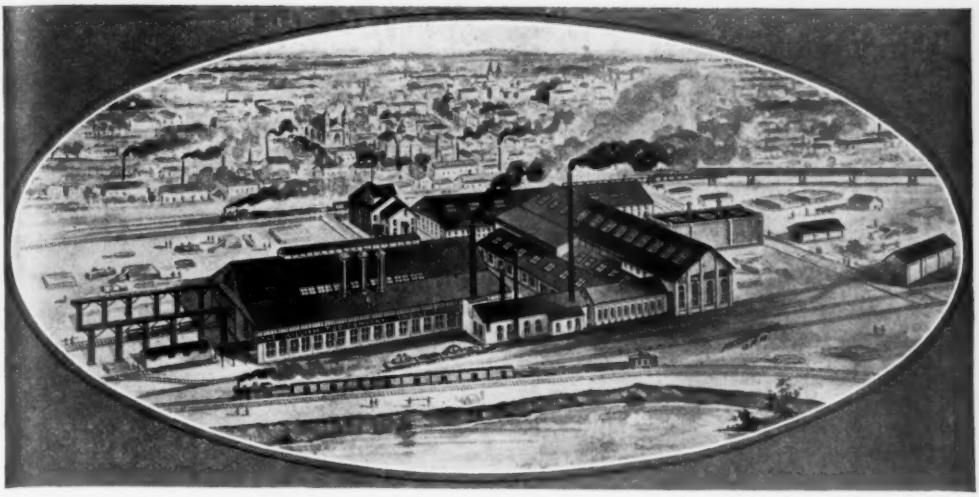
Iron for Car Wheels.

At a recent meeting of the American Society for Testing Materials, Chas. B. Dudley recounted some of his experiences in car wheel founding while connected with the Pennsylvania Railroad at Altoona, Pa. The attempts made to predict, from a chemical analysis, the amount of chill an iron would show have not proven successful, and the speaker stated that the chilling qualities of an iron were somewhat difficult to understand, as identical analysis will not produce a casting of like chill. At the Altoona shops the car wheel mixture employed contains from 3.25 to 3.60 per cent of total carbon, about 0.75 per cent silicon, 0.50 per cent manganese, 0.50 per cent phosphorus and 0.13 to 0.15 per cent of sulphur, of which the limit was formerly 0.08 per cent. The total carbon is lowered to the desired point by the addition of from 5 to 10 per cent of old steel rails. The depth of chill produced by this mixture is about 1 inch.

More Competition.

A. Abelson, the junk dealer on Margaret avenue, is soon to commence the erection of a building in which he will start a foundry. The plant will be for the making of small and light castings exclusively and will give employment to several men. Mr. Abelson has been shipping away the old iron that comes to him in the course of his business, but in the future he will utilize it in the manufacture of castings.—Altoona (Pa.) *Mirror.*

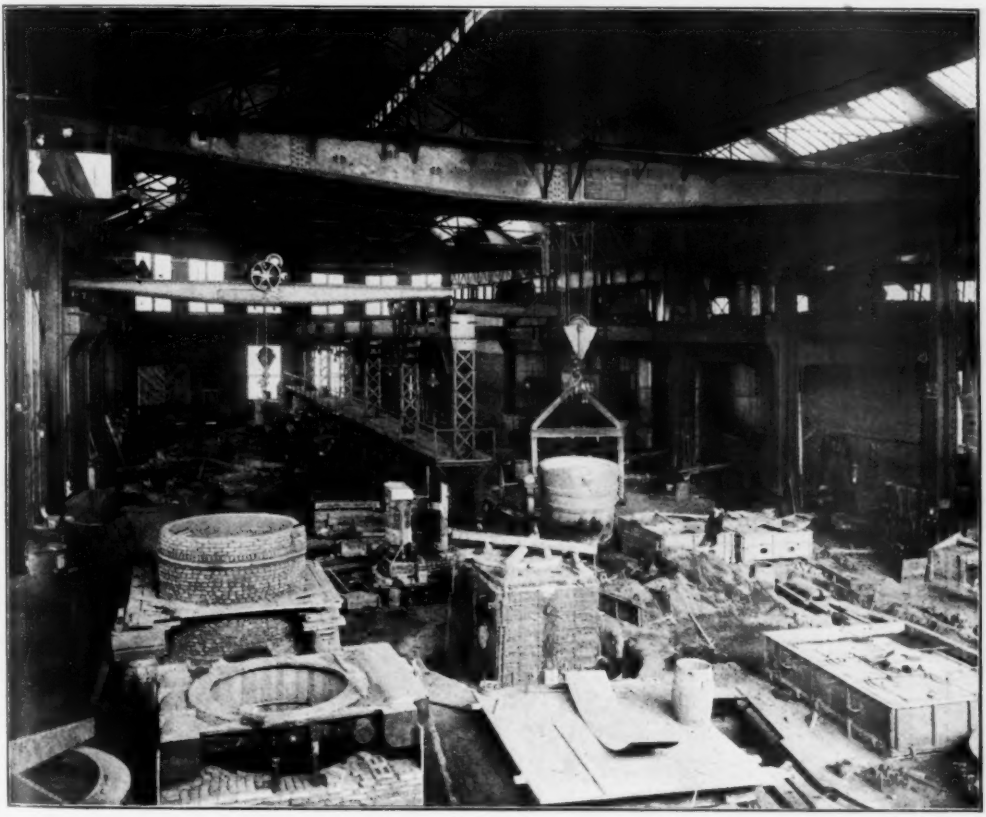
A. M. Danbury and J. J. Foley, of Cincinnati, O., have purchased a two-thirds interest in the Ball-Mitchell foundry at Maysville, Ky. The plant is to be considerably enlarged and additional molders will be employed. The concern will hereafter be known as the Maysville Foundry & Machine Co.



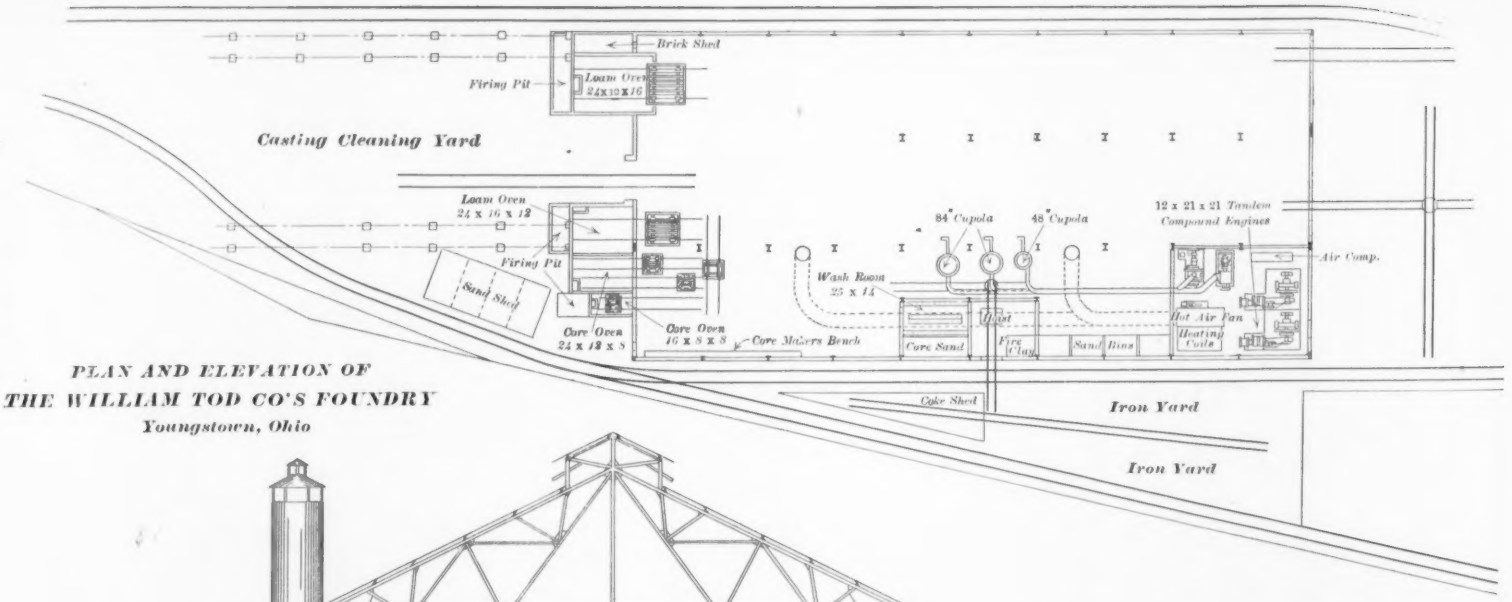
PLANT OF THE WILLIAM TOD CO., YOUNGSTOWN, OHIO.

New Foundry of the William Tod Co., Youngstown, O.

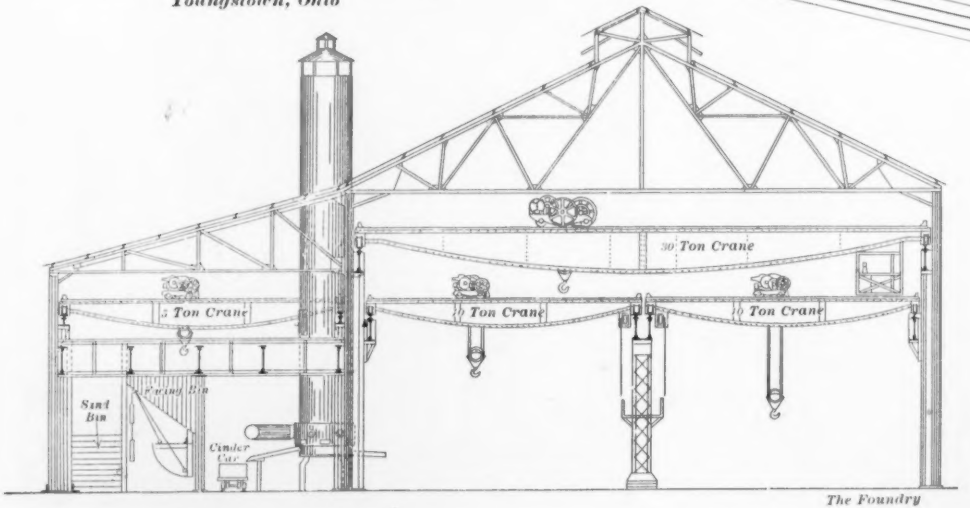
One of the pioneer foundries in the Mahoning Valley is the one operated by the William Tod Co., at Youngstown, Ohio. The plant was established in 1856 by Mr. Homer Hamilton, and during the first years of its operation did a general foundry and machine shop business, gradually drifting into the engine trade.



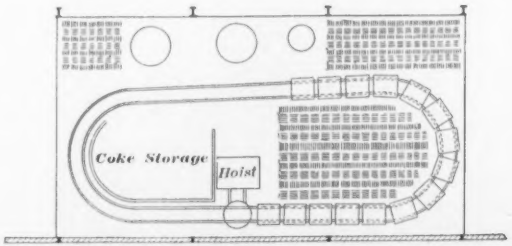
INTERIOR VIEW, NEW FOUNDRY OF THE WILLIAM TOD CO., YOUNGSTOWN, OHIO.



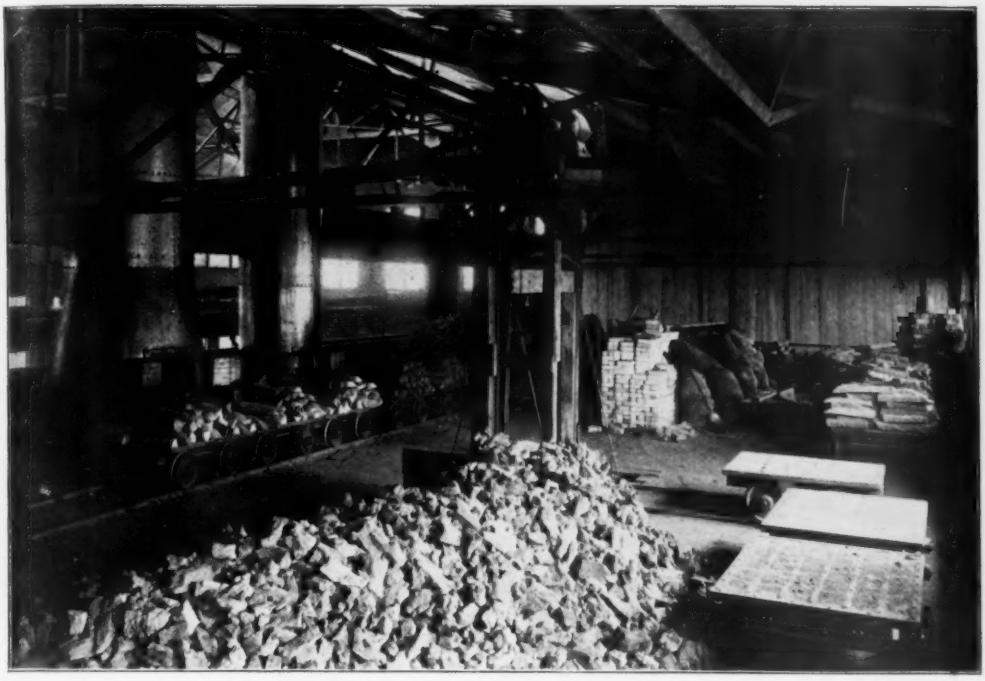
PLAN AND ELEVATION OF
THE WILLIAM TOD CO'S FOUNDRY
Youngstown, Ohio



The Foundry



Plan of Charging Platform

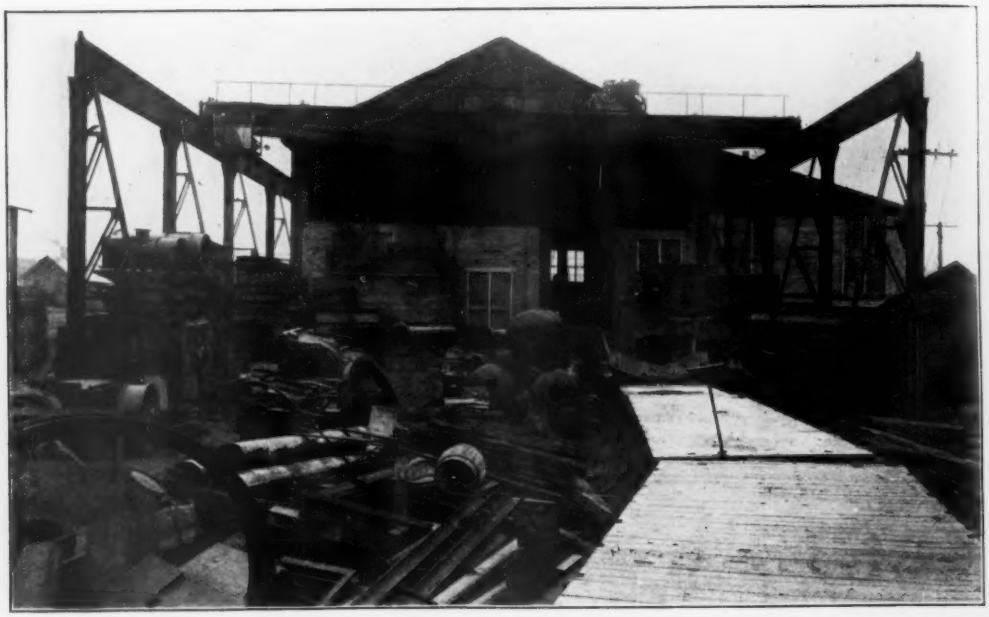


CHARGING PLATFORM SHOWING METHOD OF HANDLING MATERIAL.

Mr. Hamilton, with Mr. Charles T. Porter, designed the well known "Porter-Hamilton" engine which, largely on account of its rigid bed and frame, has been very well received by the iron and steel trades, and has done much to contribute to the reputation of the William Tod Co. as builders of high grade rolling mill engines.

The company has been operated since 1878 by William Tod & Co., a partnership, and was incorporated in 1901 as the William Tod Co. The officers of the company are: President,

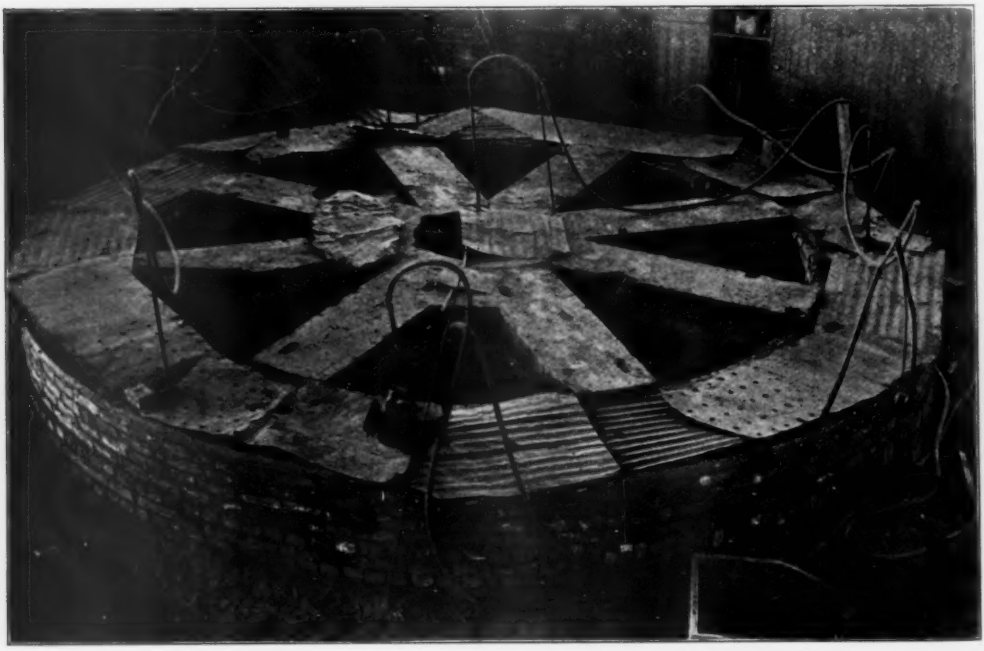
A LARGE LOAM MOLD IN COURSE OF CONSTRUCTION.



FOUNDRY YARD OF THE WILLIAM TOD CO., SHOWING RUNWAY EXTENSION, COVERED BY ELECTRICAL CRANES.

William Tod; vice president, John Stambaugh, Jr.; secretary and treasurer, Paul Jones. The manager is M. A. Neeland. The above named with Henry H. Stambaugh constitute the board of directors.

With increased business the demand upon the company's foundry became much greater than its capacity, and construction of the present shop was begun a little over a year ago. The first column of the crane runway exten-



DRYING THE MOLD FOR A LARGE FLY-WHEEL BY NATURAL GAS.

CORE DEPARTMENT OF THE WILLIAM TOD CO.'S FOUNDRY.

sion was raised on the 6th of July, and on the 14th of August the first half of the building was completed and the first cast was made in the new shop. The other half of the building was built on the site of the old foundry. During the whole of the new construction the foundry was kept in operation without the loss of a single day.

A LARGE ENGINE FRAME IN FOUNDRY OF THE WILLIAM TOD CO.

The plan and elevation of the foundry gives a general idea of the way in which this is laid out and equipped. The main building is 85 feet wide by 250 feet long, with a 40 feet leanto, in which are located the core department, cupolas, sand bins, wash room, cupola hoist, heating apparatus, air compressors and general power plant. The core department is served by a 5-ton electric crane having a span of 40 feet, the cores being transferred as they are needed to the main shop by means of a transfer car. As will be seen from the illustrations the core ovens as well as the ovens used for the drying of loam molds and cores are located outside of the building proper, though easily reached by the cranes. There are two ovens for drying loam molds, 24x16x12 feet high and 24x30x16 feet high respectively. The two core ovens are 24x12x8 feet high and 16x8x8 feet high.

The main part of the foundry is served by two 30-ton cranes of 80 feet span, commanding the whole of the shop and the runway which extends for 150 feet beyond the building and covers the yard for cleaning castings, and the space utilized for the storing of loam plates, large flasks and castings. There are also two 10-ton cranes of 40 feet span which command about one-half of the floor space of the foundry. As the illustrations show the large cranes are mounted so that they can travel over the 10-ton cranes, and may be used for any especially heavy work in this end of the shop, although the idea is that the 10-ton cranes will ordinarily be able to serve this part of the foundry. The elevated platform to be seen on the central row of columns supporting the smaller cranes, is for the use of the operator of the small cranes, which are not furnished with a cab as are the larger cranes. The class of castings turned out in this end of the foundry are such as do not require the constant operation of the cranes, and as a general rule one operator takes care of both.

In order that the 30-ton cranes may travel out onto the 150 feet extension of the runway covering the yard space this end of the foundry is provided with a swinging door, 15 feet high and 80 feet wide, the movements of which are controlled by an electric motor. One of our illustrations gives a view of this part of the works when the cranes are used outside of the building. At the time this photograph was taken the runway had not been completed to its full length, and it now extends a considerable distance beyond the columns there shown.

One corner of the foundry is taken up by the engine room which contains one No. 6 and one No. 7 Baker blowers direct connected. Power for driving the tools in the machine shop is also generated in this department, and a compressor furnishes air for the foundry, cleaning yard and machine shop. The foundry is heated by the indirect method, using exhaust steam in heating coils, distributing the heat by means of a 10-foot fan and underground brick ducts leading to two risers, thus doing away with all overhead piping.

There are two 84-inch and one 48-inch cupolas, lined to 66, 60 and 40 inches respectively, supplied from one common blast main. The charging floor is reached by an electric hoist of 5-ton capacity and is arranged as shown in the general plan of the foundry, lower right hand corner. On the charging platform is a continuous track 36-inch gauge, on which are placed a train of loaded charging cars. These cars are taken up from the iron yard during the forenoon and in the afternoon the entire charge is stored upon the platform on wheels, and is rolled in front of the cupola as required, thus doing away with any rehandling and reducing the labor to a minimum. There is also stored upon the platform a supply of pig iron and coke to be used in case of failure of the hoist or other apparatus.

The iron yard is just outside of the foundry, and is reached by a narrow gauge track. On this track there is a combined transfer and scale car, the scale car being arranged with furnace charging beams and carrying the small cupola charging car on its platform upon rails at right angles to its track. The proper mixture is made up upon these charging cars, using one beam for each kind of iron, and the transfer car is then brought opposite the track to the cupola platform and the little car pushed off and carried to the cupola floor.

The sand bins are located in the leanto and are filled from cars as these are switched onto the sidetrack reaching this part of the works.

Below the floor of the charging platform and above the sand bins are located bins for facings, flour, core compound, etc. These are reached through manholes in the charging platform and chutes connect them with the main floor of the foundry. In the rear of the cupola is a well equipped wash room. In the general construction of the building attention has been paid to the convenience and comfort

of the workmen, especially in the matter of light and ventilation.

The heavy character of the castings turned out in the foundry of the William Tod Co. is shown in a recent heat of 125 tons, of which 80 tons were required for a single casting, a bed-plate for one of their large engines. Another innovation at this shop is the introduction of a slag car, into which is received the slag from the cupola, instead of having this scattered over the floor in the rear of the cupola. A square cast iron box is mounted on narrow gauge trucks, and before any slag enters same a heavy wrought iron hook is placed in the center of the box. When the slag has cooled off a crane is hitched onto the hook and the whole mass of slag is removed in a body, thus avoiding extensive handling as well as the annoyance of having coke and iron mixed up with the slag when the bottom is dropped.

A reference to the illustration showing a general view of the interior of this foundry makes it plain that the greater part of the output is heavy castings. Many of these are molded in loam and dry sand, and the method of drying some of these molds, which are too large to be handled, by natural gas, as shown in the illustrations of a large flywheel, is one that must commend itself for cleanliness and general efficiency. In the mold shown gas burners are distributed throughout the rim of the wheel as well as one in the hub, all of these being connected with the main supply of this fuel through rubber hose as shown.

CAST IRON NOTES.

Devoted to inquiries from Practical Foundrymen on the subject of Melting and Using Cast Iron. Address all inquiries to W. J. KEEP, care of The Foundry.

Calculating a Cupola Mixture.

In Cast Iron Notes for June I mentioned a proposed reduction in rates for chemical analysis in complimentary terms. Since that time it has come to my knowledge that no great concession has been made.

If, as is claimed, a determination of silicon can be made in 20 minutes it would seem that a rate less than $1.00 could be made as an encouragement to founders. In the same issue I suggested that it would be a great favor if some one would give a simple method for figuring a mixture. I have received quite a number of requests for this information and have replied to each by letter hoping that some one would, through THE FOUNDRY, give a better method of mixing by chemical analysis than I could give. As such a description has not been given I will reply to a request just received.

Question—Given a good coke and the following mixture:

	Lbs. Iron		Silicon per cent		Silicon Lbs.
Return	700	×	2.46	=	17.22
Old scrap	200	×	2.00	=	4.00
No. 1 soft	300	×	2.75	=	8.25
No. 2 foundry .	600	×	2.50	=	15.00
Silvery gray ...	200	×	4.00	=	8.00
	2,000	×	2.62	=	52.47

As about .25 per cent silicon is lost the percentage in the casting would be 2.62—.25=2.37. These irons are said to be good and regular Southern irons. The shrinkage of a ½-inch square test bar from the above mixture was .165 and the strength was 375 pounds. Now you reduce shrinkage by increasing the silvery gray and reducing No. 2 foundry. How low can you expect the shrinkage to be carried before it will *turn* and increase? Where is the turning point? Would it go down to .130 and if not what would be the probable cause?

Suppose that you increased the silvery gray to 500 and reduced No. 2 foundry to 300 and there was not the corresponding reduction of shrinkage which was to be expected, say it only lowered to .150 would you make farther increase of silicon?

Answer—Yes. Figuring the last mentioned mixture as before we find that there will be 2.66 per cent silicon in the casting. One trouble in this case is with the composition of your irons. The analysis is evidently a furnace analysis and not of each car as received. You figure the silicon at 2.37 per cent and 2.66 per cent. You find by actual measure that the shrinkage is .165 and .150 whereas (*Cast Iron*, page 156) it should be .150 and .140. This proves that the percentages of silicon used in the calculation are not correct. This is the reason for the shrinkages being higher than expected.

To produce .130 shrinkage the casting should contain 3.25 per cent silicon. This cannot be produced with these irons. Suppose that we take a silvery iron with silicon 7.00 per cent and that we make a mixture with 3.50 per cent silicon or 3.25 per cent in the casting. The return would contain 3.25 per cent.

It is the custom with many chemists in figuring mixtures to vary the amounts of iron and

to figure each trial mixture as shown until a mixture is found with the required silicon percentage.

[NOTE.—A chemist writes the number denoting a percent 1.75, but in examples like the above he points off the product as though he had written the percent .0175. To avoid mistakes the founder had better use the last form.]

My method of calculation is as follows: The weight of the return, scrap and some of the pig irons, as well as the total weight of the charge and the silicon percentage, are definite. We must keep out two irons to produce the required weight of the charge and the percentage of silicon. As before, let this be the silvery and No. 2, though I prefer an iron with higher silicon, as for example the No. 1 soft.

	Lbs. Iron		Silicon per cent		Silicon Lbs.
Return	700	×	3.25	=	22.75
Scrap	200	×	2.00	=	4.00
No. 1 soft	300	×	2.75	=	8.25
	1,200	×	2.92	=	35.00
Required	2,000	×	3.50	=	70.00
	70.00	—	35.00	=	35.00

We therefore require 800 pounds of iron containing 35.00 pounds of silicon or with 4.38 per cent and we are to use such proportions of the 7.00 per cent silvery and of the 2.50 per cent No. 2 as will give this:

No. 2 contains 4.38—2.50=1.88 per cent, too little silicon.

Silvery contains 7.00—4.38=2.62 per cent, too much silicon.

We must take 2.62 parts of No. 2 and 1.88 parts of the silvery, or 4.50 parts in all.

800÷4.50=178 pounds which equals one part.
178×2.62=466 pounds of No. 2.
178×1.88=334 pounds of silvery.

Use even weights, 460 and 340.

This can be proved by figuring the whole mixture as in the first case, or as follows:

No. 2.....460×2.50=11.50
Silvery.....340×7.00=23.80

800×4.41=35.30

1200×2.92=35.00
800×4.41=35.30

2000×3.51=70.30

3.51—.25=3.26 per cent silicon in the casting.

By the shrinkage chart (*Cast Iron*, page 156) 3.25 per cent silicon is expected to give .128 shrinkage. It will be a little higher or lower according to varying conditions and the proportion of other elements.

The shrinkage will continue to decrease with silicon as high as 3.50, and as this is as high as will ever be required for the lightest castings it is safe to say that there is no turning point. I often get .118 shrinkage for stove plate with silicon about 3.50 per cent.

The sulphur and phosphorus in a mixture can be figured in the same way as silicon.

We have just shown that with 2.40 per cent silicon a shrinkage of .150 was expected. With 2.66 per cent silicon .140 shrinkage was expected, and with 3.25 per cent silicon .128 shrinkage is expected.

Is it not evident that the rule will work both ways and that .128 shrinkage indicates approximately 3.25 per cent silicon and so on, and that if the shrinkage continues uniform each day the quality of the casting continues uniform.

In other words, the measure of shrinkage is a mechanical analysis of silicon. We all figure a mixture by chemical analysis whether we know the silicon in the pig iron or scrap or remelt by actual analysis or from figures given us by the furnace that supplies the pig iron.

The only way to find whether the figured percentage of silicon produces the required physical quality is to measure the physical quality. If the shrinkage is too high we increase the silicon.

Buying Pig Iron and Coke.

BY W. G. SCOTT.

In former years pig iron was graded by *fracture;* a very open grain being designated as a No. 1 iron, a medium grain as No. 2 and a close grain as No. 3 iron. The harder irons were graded according to fracture and *color*, a white iron being the extreme of hardness, while the mottled irons were classed in between the soft and hard grades.

Buying iron by fracture is like buying butter by color, and amounts to about the same thing as it is an easy matter to change the grain of an iron or alter the color of a sample of butter.

Fracture in iron is an approximate indication of the relative proportions of graphitic and combined carbon, and is not in all cases an index of the hardness or softness of the iron.

In extreme cases, color is a better indicator as there is no mistaking the hardness of a white iron. Hard white iron, with a close grain, if remelted and allowed to cool slowly, will be entirely different in color, be softer, and have a more open grain.

Slow cooling opens the grain, rapid cooling or chilling closes the grain, consequently an

iron poured extremely hot, and covered with sand so as to retard the cooling, will have an open grain; whereas the same iron if cooled quickly by drenching with cold water, will not only have a closer grain but will be correspondingly harder, due to the fact that the greater part of the graphitic carbon has been changed to the combined form.

In making pig iron very few, if any, of the blast furnaces mix their ores by color or other guess work methods, and they would not think for a minute of buying ore by color or general appearance, in fact they are most particular in regard to a complete and accurate anaylsis of not only the ore, but of the limestone flux and the fuel.

It is said that "there is no guess work in the manufacture of steel," and at the present date it is safe to assert that the modern blast furnace is abreast of the times and working on scientific lines. There is no more progressive element in America today than the iron men, and as a rule there is no poor pig iron.

High phosphoric pig iron (with little strength, but good fluidity), is totally unfit for use alone, except in light castings where strength is of no account; but this same iron mixed with a low phosphorus pig iron so as to produce the proper per cent of phosphorus in the casting, becomes quite as valuable as other irons.

The finest kind of malleable Bessemer with phosphorus at 0.10 per cent would alone be unfit for gray iron castings in most foundries on account of its lack of fluidity, or in other words it would be too "sluggish" for the work.

This illustration leads up to the point under consideration, i. e., the proper method of buying pig iron, and it is essential that the purchaser should have some knowledge of the grade of castings to be produced. In the first place some sort of grading must be adopted that will conform with the chemical composition of the iron, after which it is an easy matter to make mixtures to fit any class of work.

Where strength is the main object the phosphorus, graphite and sulphur must not be too high. The foundry can regulate the graphite; the sulphur must be corrected in the fuel and iron; and the phosphorus looked for in the pig only.

Now if the purchasing agent happens to buy a lot of high phosphorus iron, he should offset the bad qualities of this iron by purchasing a low phosphoric pig in quantity sufficient to get the desired mixture. Thus if 1,000 tons of iron run 1.20 per cent of phosphorus, it would require 1,000 tons of 0.40 per cent phosphorus to produce mixtures or castings with 0.80 per cent of phosphorus.

In the case of sulphur, the buyer has to consider coke as well as pig iron, therefore on the supposition that coke gives to the iron 4 or 5 per cent of its sulphur it will be necessary to buy a low sulphur iron if you are using a high sulphur coke.

The average sulphur figures for the various cokes on the market today will run about as follows: 0.60, 0.75, 0.85, 1.00 and 1.20 per cent. A coke of 0.75 per cent sulphur giving 4 per cent or .03 sulphur to the iron, a coke of 1.00 per cent sulphur would give .04 sulphur to the iron.

It used to be the practice to add .03 sulphur for all cokes, but at the present time most of the cokes are higher in sulphur, consequently this figure is too low. The better plan is to add *five* per cent of the sulphur content, in which case you are on the safe side.

With coke fixed at a limit of 1.00 per cent sulphur, the absorption figure for iron would be 0.05 per cent. With pig iron limited to 0.05 per cent sulphur, the castings would contain 0.100 per cent of sulphur which is by custom fixed as the danger limit of this element in the best grade of castings where strength, softness, shrinkage, etc., are considered.

The main feature in buying iron and coke is to get material which when mixed properly will produce the desired grade of castings. The castings must be soft enough to be machined, hence the proper silicon; they must not be extremely hard or have an excessive shrinkage, hence not be too high in sulphur; where strength is desired the phosphorus must be kept down, and manganese not too low or too high.

In a nut shell, silicon, sulphur, phosphorus and manganese govern the value of a pig iron so far as a specification is concerned, and the purchasing agent need only consider these elements. Phosphorus and manganese will not vary much in the same brand of iron as long as the same ore is used, consequently a complete analysis of every car of material need not be made, but it is a good plan to know where the phosphorus and manganese are in the *different brands* of iron.

Silicon and sulphur are governed to a great extent by furnace conditions, consequently *each car* should be analyzed for these two

metalloids. In some classes of work it is customary to make a determination of manganese for every car, but is not necessary in ordinary foundry work.

In regard to specifications for pig iron, it may be mentioned that each manufacturer has some sort of specification which is either printed or typewritten, and that the body of the specification is invariably based on the chemical constituents of the iron in place of fracture.

The J. I. Case Pig Iron Specifications when first printed were limited to one or two hundred copies, but were exhausted in a very short time. Last year nearly 10,000 copies were printed and used, the greater number being mailed to parties requesting a set of these specifications. Letters are being continually received from all parts of the world asking for these specifications and the editions are exhausted as soon as printed.

J. I. CASE THRESHING MACHINE CO.'S SPECIFICATIONS FOR FOUNDRY PIG IRON.

Under these specifications we desire a good, clean iron, as free as possible from dross, kish, oxide, sand, etc.

The per cent of "sows" must not vary to any great extent from the usual amount found in a strictly graded iron, according to the old fracture method.

All grades of pig iron will be bought strictly by analysis, and must conform to the following specified per cents:

FOUNDRY NO. 1.

Silicon, must not be less than.....2.50 per cent
Sulphur, must not exceed..... .03 per cent
Phosphorus, should not exceed..... .60 per cent
Manganese, should not exceed..... .50 per cent
Total carbon, not specified.

The carbons will usually be between 3.00 and 4.50 per cent in this grade.

Any car of No. 1 Foundry Pig which shows on analysis less than 2.40 per cent of silicon or more than 0.035 per cent of sulphur will be rejected. (See remarks under head of note.)

FOUNDRY NO. 2.

Silicon, must not be less than.....1.95 per cent
Sulphur, must not exceed..... .04 per cent
Phosphorus, should not exceed.....70 per cent
Manganese, should not exceed..... .70 per cent
Total carbon, not specified.

The carbons in No. 2 will generally range from 2.90 to 4.20 per cent.

Any car of No. 2 Foundry Pig which shows an analysis less than 1.85 per cent of silicon or more than 0.045 per cent of sulphur will be rejected. (See note.)

FOUNDRY NO. 3.

Silicon, must not be less than.....1.35 per cent
Sulphur, must not exceed..... .05 per cent
Phosphorus, should not exceed..... .80 per cent
Manganese, should not exceed..... .90 per cent
Total carbon, not specified.

The carbons in this grade will usually be between 2.50 and 4.00 per cent.

Any car of No. 3 Foundry which shows on analysis less than 1.25 per cent of silicon or more than 0.055 per cent of sulphur will be rejected.

NOTE.—It is distinctly understood that all grades of Pig Iron will be bought according to analysis and not by fracture.

As we mix by analysis in the foundry, it necessarily follows that the pig iron should be according to specifications; furthermore if we accept an iron as No. 2 which fails to fill the No. 1 conditions, we might eventually be overstocked with No. 2 and be unable to get the results aimed at in the cupola mixture; consequently an iron sold as No. 1 or any other specified grade, will be rejected if not strictly within the specifications for said grade.

When a car of pig iron is received it will immediately be sampled by an experienced man (professional sampler) who will select a certain number of pigs from different parts of the car, which according to his judgment shall represent the *average* quality of the iron. These pigs will be broken and drillings taken from the face of the fracture will be sent to the laboratory for a chemical analysis. The analysis will decide the acceptance or rejectment of the iron.

Rejected cars will be held subject to the shipper's order.

In case of dispute, the furnace or the seller shall have the right to resample the iron in conjunction with the buyer, each to select five pigs.

Drillings from the ten pigs, after being well mixed, will be divided into three different samples, one lot to be analyzed by the furnace, one by our laboratory, and one by a disinterested chemist, agreed upon by the parties in dispute.

The two analyses nearest alike will be accepted as the proper chemical composition of the iron.

In all chemical work relating to pig or cast iron, it is understood that the standardized drillings furnished by the American Foundrymen's Association are to be used as "standards."

The following chemical methods are used in our laboratory, viz.:

Silicon—Drown's method.

Sulphur—Evolution and titration with iodine (volumetric), as a rapid method, and the oxidation method (gravimetric) in all cases of dispute.

Phosphorus — "Emmerton's Method" for rapid work, and the "Molydate Magnesia" method for very accurate determinations.

Manganese—Deshay's or the colormetric method for rapid work, and the "Acetate process" for extremely accurate work.

Carbons—Carbons are worked by the colormetric and combustion methods.

In case of dispute, check analyses are made by gravimetric methods.

SILVER GRAY (S. G.) OR SILICON PIG.

Under this specification we expect a pig iron medium high in silicon and not too low in graphitic carbon. This iron is to be used as a softener.

Silicon, must not be less than.....3.00 per cent
and should not be more than.....5.50 per cent
Sulphur, must not exceed..... .04 per cent
Phosphorus, should not exceed..... .90 per cent
Managnese, should not be less than..... .30 per cent
Total carbon, should not be less than.....2.50 per cent

Any car of S. G. iron, showing on analysis less than 3.00 per cent of silicon, or more than 0.055 per cent of sulphur will be rejected.

FERRO-SILICON PIG IRON.

Under this specification we prefer a pig iron with about 8.00 per cent silicon.

The general range for silicon in this grade is from 6.00 to 12.00 per cent.

Silicon, must not be less than..... 7.00 per cent
or more than.....12.50 per cent
Sulphur, must not exceed..... .04 per cent
Manganese, not specified.
Total carbon, not specified.

As a rule the graphitic carbon will be low, varying from 3.00 to 0.50 per cent.

Manganese may occasionally vary from 0.20 to 3.00 per cent or more.

Cars will be rejected which show less than 6.00 per cent of silicon, or more than 0.045 per cent of sulphur.

MANGANESE PIG (MANGANIFEROUS IRON.)

In this specification we desire an iron of from 1.00 to 2.50 per cent manganese.

The ordinary No. 1 pig iron, running about 1.50 per cent in manganese, will fill all the conditions required.

Silicon, should not be less than.....2.50 per cent
Sulphur, must not exceed..... .04 per cent
Phosphorus, should not exceed..... .70 per cent
Manganese, must not be less than..... .90 per cent
Carbon, not specified.

As a rule, the higher the manganese, the greater the proportion of combined carbon.

Combined carbon may range from 0.30 to 3.00 per cent, while the graphitic carbon may vary from 0.40 to 3.50 per cent.

NOTE.—A few remarks on manganiferous irons may help to define the dividing line between the ordinary foundry pig and the regular manganese iron.

Manganese pig is an ordinary iron made from ore containing somewhat more manganese than the regular foundry irons; it will run from 0.80 to 3.50 per cent in manganese. It is added to foundry pig, in cupola practice, to raise the combined carbon, thereby increasing the strength. In a measure it neutralizes the effect of sulphur, removes excess of gas and prevents blow holes. It must, however, be used with caution, as a low silicon and carbon, with high manganese, gives hard iron and alters the shrinkage.

Spiegel iron is used mostly in steel making. It is supposed to contain from 10 to 25 per cent of manganese, but some authorities place the range from 3.50 to 20 per cent.

Ferro-manganese contains from 25 to 90 per cent of manganese. Most of the ferro-manganese on the market runs about 80 per cent of manganese. With 80 per cent of manganese present, there is not much room for iron. The metal, however, usually contains sulphur, phosphorus, carbon and silicon.

In cupola practice the amount of ferro-manganese used is generally very small, consequently the effect of the other metalloids is not great.

Manganese has a tendency to keep the carbon in the combined form; hence it lowers the graphitic carbon, thereby reducing the deflection. It neutralizes the effect of sulphur by reducing "red-shortness," and indirectly offsets the "cold-shortness" or brittleness caused by high phosphorus.

In foundry practice, the more manganese present in the pig, the more silicon and graphitic carbon required to produce soft castings.

For "chill mixtures," where great toughness is required, a pig with 2 per cent manganese and less than 1 per cent silicon is a desideratum.

MALLEABLE BESSEMER PIG.

This specification will cover both the "common" and "straight" malleable Bessemer.

When the "straight" Bessemer pig is specified, it is understood that the phosphorus is not to exceed 0.10 per cent. Straight Bessemer with 1.00 to 1.50 per cent of silicon, about 0.60 per cent manganese, under 0.11 per cent phosphorus, and below 0.04 per cent sulphur, will be satisfactory.

In "common" Bessemer the following limit will be specified:

Silicon, may range from.....0.70 to 2.10 per cent
(Silicon of.....per cent. preferred.)
Sulphur, must not exceed..... .045 per cent
Phosphorus, must not exceed..... .15 per cent
Manganese, may range from....0.30 to 1.20 per cent
(Manganese of.....per cent, preferred.)
Total carbon, should not exceed.....3.75 per cent

As a rule, the combined carbon will vary from 0.30 to 1.30 per cent, and the graphitic carbon from 3.45 to 1.80 per cent.

Preferred figures will be marked in red ink, and when specified, we expect to get an iron not varying more than 0.10 per cent either way. When no preferred figure is specified, the silicon and manganese may be anywhere within the above limits.

The iron will be rejected if the analysis shows more than 0.05 per cent of sulphur, or more than 0.18 per cent of phosphorus.

CHARCOAL IRONS.

Charcoal iron differs from coke iron mainly in regard to the carbon.

The graphitic carbon appears to be in a finer state of division, and when changed into the combined form it produces a closer grain and stronger metal than does a coke iron with the same amount of total carbon. It is especially adapted to "chill work," and by regulating the amount of silicon and carbon, it is possible to get any desired chill.

The sulphur, phosphorus and manganese are quite constant in charcoal iron; the silicon and carbon vary to a decided degree, and these two elements will govern the various grades.

Graded according to fracture, there are usually seven distinct grades, designated by letters and numbers, and in some cases branded as "soft," "foundry," "medium," "high," "low," etc. (high and low referring to carbon).

Charcoal iron ranges in silicon from 0.30 to 3.00 per cent. The total carbon will run from 2.50 to 4.50 per cent, in some cases even higher.

In this specification we shall not specify any grade or number, but will ask for "preferred" per cents, as follows:

Silicon, general total range.....0.30 to 2.75 per cent
(Silicon of.....per cent. preferred.)
Sulphur, must not exceed..... .025 per cent
Phosphorus, must not exceed..... .25 per cent
Manganese, should not exceed..... .70 per cent
Total carbon, general range.....2.50 to 4.50 per cent
(Carbon of about.....per cent desired.)

Preferred figures to be marked in red ink.

"Low" carbon will be understood to closely approximate 2.50 per cent, "medium" carbon as 3.50 and "high" carbon as 4.50 per cent or above.

NOTE.—Charcoal iron gives a "chill" in accordance with the amount of silicon present, the other constituents remaining constant, or nearly so.

The following table is approximate, but near enough to give some idea of the effect of silicon on the carbon:

0.30 per cent silicon is equivalent to 1½ in. chill.
.40 per cent silicon is equivalent to 1 in. chill.
.52 per cent silicon is equivalent to ⅝ in. chill.
.70 per cent silicon is equivalent to ¼ in. chill.
1.00 per cent silicon is equivalent to ⅛ in. chill.

Above 1.00 per cent a chill may be induced by increasing the sulphur, or by altering the amount of manganese and carbon.

With manganese at 0.50 per cent and sulphur at 0.095 per cent in a mixture, the castings will take on a decided chill even with medium high silicon.

Sulphur increases, silicon diminishes, manganese toughens or stiffens, and phosphorus remains neutral in regard to chill.

A high carbon will give a hard, shallow chill, while a low carbon gives a soft, but deeper chill.

Chill is governed to a great extent by the cooling of the molten iron, different results being obtained by pouring against a large or small surface chill plate; also in pouring horizontally or vertically against the chill. A reverberatory furnace gives better results than a cupola in chilled work, due to the different effect on silicon.

PHOSPHORIC PIG IRON.

Phosphoric iron is used almost exclusively for small thin castings, where great "fluidity" is desired.

A very fluid iron is essential in thin work as it fills every part of the mold and gives a clear solid casting.

Iron high in phosphorus is very weak and brittle under impact (shock), consequently it can not be used where great strength is required. With high silicon and a high graphitic carbon, the phosphorus may rise to 1.00 per cent in the casting, but in chilled work with low silicon and much combined carbon, the phosphorus must be kept below 0.30 per cent.

This specification calls for an iron within the following limits, viz.:

Silicon, must not be less than.....1.50 per cent
(A higher silicon preferred.)
Sulphur, must not exceed ..... .055 per cent
Phosphorus, should not be below.....1.00 per cent
Manganese, may range from.....0.30 to .90 per cent
Total carbon, should not be below .....3.00 per cent

Any car of iron showing on analysis more than 0.06 per cent of sulphur, or less than 0.90 per cent of phosphorus, will be rejected.

REMARKS:—These specifications will be submitted whenever a purchase of pig iron is to be made, with the distinct understanding that there is to be no deviation from the figures specified.

SPECIAL CONTRACT.

(Pig Iron.)

NOTE.—In our specifications for pig iron the words, "must not" are to be considered as an arbitrary term and admit of no radical change from the specified figure.

The term, "should not" is intended as a suggestion in regard to what we desire, but is not strictly an absolute factor.

In the event of the party selling pig iron not being able to meet the requirements of the regular specifications, it is proposed that such "off grade" iron be purchased under *special contract*, such contract plainly stating the minimum or maximum limit of silicon, sulphur, etc.

The party selling the iron is to fill in the blank space with the minimum or maximum amount of the metalloids, and if satisfactory to the purchasing agent both parties are to sign the following contract:

SPECIAL PIG IRON.

Brand .....

Silicon, not less than.....per cent
Sulphur, not over.....per cent
Phosphorus, not over.....per cent
Manganese, between .....and.....per cent

REMARKS: .....

.....

Signed .....

.....Purchasing Agent.

SPECIFICATIONS FOR FOUNDRY COKE.

Under this specification we desire a good, clean, 72-hour coke; as free as possible from coke dust and cinder.

The percentage of wall coke, known as "black heads" must not be greater than that usually found in "Selected" No. 1 foundry coke.

The coke should be of the massive form, and reasonably free from small particles, *i. e.*, granulated coke.

"Structure" is an important feature and will be considered when purchasing coke.

The structure of a perfect 72-hour coke, should according to theory, be made up as follows:

Cellular structure .....56.00 per cent
Coke structure .....44.00 per cent

We do not expect to get a coke with an ideal structure, but we do insist on a coke with a proper structure for cupola work.

Our castings are made according to specifications; and, as the iron is mixed by analysis, it is absolutely necessary that the coke be low in sulphur and phosphorus.

Well washed coke should not exceed the amount of sulphur herein specified.

When a car of coke is received it will immediately be sampled by an experienced man, who will select two average samples (ten pieces) of the coke from different parts of the car, and these two samples will be sent to the laboratory for a check analysis.

The coke will be accepted if it comes within the following limits, viz.:

Moisture, should not exceed..... 1.50 per cent
Volatile matter, should not exceed..... 3.50 per cent
Fixed carbon, must be above.....86.00 per cent
Sulphur, must not exceed..... .75 per cent
Ash, may range from.....5.50 to 11.50 per cent

Coke will be rejected which shows on analysis.

Sulphur, more than ..... 0.85 per cent
Phosphorus, more than..... .05 per cent
Fixed carbon, less than.....85.00 per cent
Ash, less than ..... 5.00 per cent

These limits will be strictly adhered to and no concessions made in any case.

NOTE.—The Heinrich method is used for all determinations in the proximate analysis of coke, except sulphur, which is determined by Eschka's method.

When sulphur is included in an analysis, it is to be understood that the volatile matter carries one-half and the fixed carbon the other half of the per cent due to this element.

The two following analyses of a "light" and a "strong" coke will give a good idea of our method and statement of a coke analysis.

Both of these cokes are within the limits of the specification; No. 1 is a "light" coke and No. 2 is a "strong" heavy coke.

	No. 1.	No. 2.
Moisture	0.33 per cent	0.49 per cent
Volatile matter ..	2.25 per cent	1.31 per cent
Fixed carbon	90.54 per cent	87.46 per cent
Sulphur	.60 per cent	.72 per cent
Ash	6.28 per cent	10.02 per cent
Structure, cells...	52.94 per cent	50.04 per cent
Structure coke ...	47.06 per cent	49.96 per cent
Specific gravity...	1.697	1.890
Heat units, per lb.	13540.	12937.

No. 1 is a light coke with medium porosity, and will give a quick intense heat.

No. 2 is a strong coke, and will hold up a heavier burden of iron; the porosity is lower (*i. e.*, the coke is more dense), consequently a stronger blast is required.

A strong, heavy coke will give a steady continued heat.

The Cost Keeping System of an Ohio Jobbing Foundry.

The foundry whose cost system is outlined in the following article employs a large force of workmen on a great variety of work. The workmen, comprising molders, coremakers, mechanics, apprentices and laborers, are enumerated on the daily time report in Fig. 1, each workman being designated by a number and his occupation of the day having an order number or numbers, to account for the time spent on that work. By way of proportion it may be pointed out that the workmen's numbers on the time report run from 1 to 75 for molders, from 75 to 100 for coremakers, from 100 to 125 for crane men, machinists and engineers, from 125 to 150 for apprentices and from 150 to 250 for general laborers.

In describing the system, we may appropri-

TIME REPORT. ..... 190 .....

No.	Time	DISTRIBUTION	No.	Time	DISTRIBUTION	No.	Time	DISTRIBUTION	No.	Time	DISTRIBUTION	No.	Time	DISTRIBUTION	No.	Time	DISTRIBUTION
1		MOLDERS	61		MOLDERS	121		MECHANICS	181		LABORERS	241		LABORERS	301		LABORERS
2			62			122			182			242			302		
3			63			123			183			243			303		
4			64			124			184			244			304		
5			65			125			185			245			305		
6			66			126			186			246			306		
7			67			127			187			247			307		
8			68			128			188			248			308		

FIG. 1. DAILY TIME REPORT.

TOTAL LABOR																				
	Men's Nos.	Hours	Rate	Men's Nos.	Hours	Rate	Men's Nos.	Hours	Rate	Men's Nos.	Hours	Rate	Amount	Molding	Core	Direct Labor	Cleaning	Molding	Core	Direct Labor	Cleaning

FIG. 2. DAILY SUMMARY OF LABOR.

Material Used in ..... Week Ending ..... 190 ..

	PITTSBURG SAND.	MASSILLON SAND.	SHARP.	SILICA ROCK SAND.	BLACKING.	COAL FACING.	X. X. FACING.	FLOUR.	MOLASSES.			
SUNDAY,												
MONDAY,												
TUESDAY,												
WEDNESDAY,												
THURSDAY,												
FRIDAY,												
SATURDAY,												
TOTAL,												

Signed, ...

FIG. 4. WEEKLY LIST OF MATERIAL.

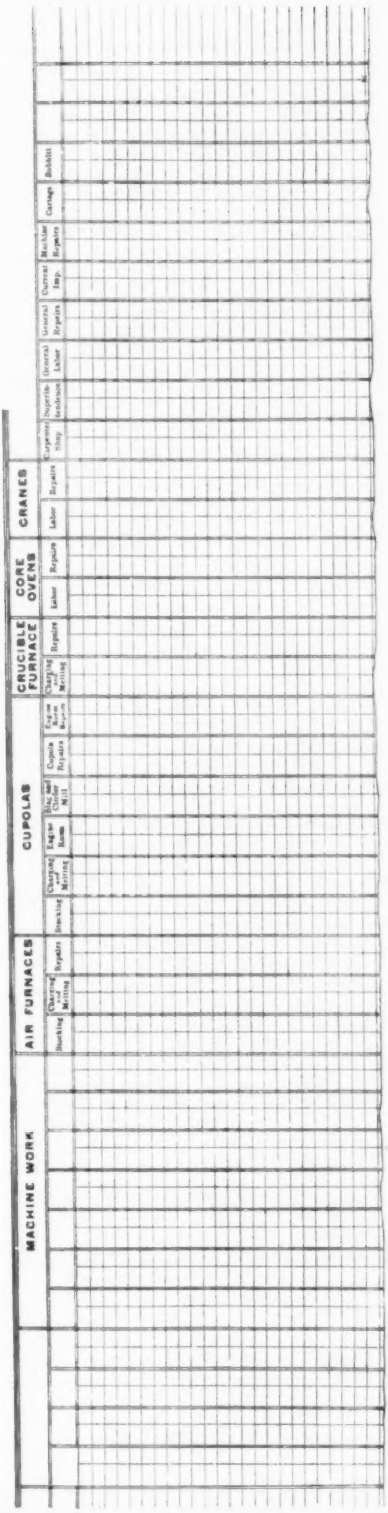


FIG. 3. SUMMARY OF WORK IN MELTING AND DRYING DEPARTMENTS.

ately commence with the labor cost. The daily time report is obtained by a clerk from each of the workmen and entered upon the form illustrated in Fig. 1. The sheet, of which only a fragment can readily be shown in Fig. 1, is 11¾ x 16¾ inches. The amount of labor, both in rate of remuneration and total time expended, is entered upon the daily labor report shown in Fig. 2. This sheet in the original is 17½ x 37¾ inches and, as in Fig. 1, it is necessary in order to insure clearness in the details to take but a small portion of the form for illustration. It will be readily understood that the columns covering the entries for "Molding, Core, Direct Labor and Cleaning" are repeated on that portion of the sheet which is omitted from the engraving. Fig. 2 is a daily summary covering not only the individual labor expense, but each of the columns to the right is reserved for an account of the labor expended on any particular piece or class of work, the labor accounted for on the right of the sheet being balanced by the workmen's credits on the left. The various totals are derived from the amounts as apportioned to the different jobs and the individual labor bestowed upon the work. The original sheet from which Fig. 2 was made is 17 x 36 inches. Strictly speaking the engraving should show a broken line at the extreme right like the one indicating a fracture at the bottom of the illustration.

Fig. 3 is a summary of the work expended in the melting and drying departments. The sheet illustrated by Fig. 3 is 17 x 23 inches.

The material used is given on the form seen in Fig. 4, the items being separated by the day's requirements and the totals can be checked off in the office from the stock records. The storekeeper in sending out supplies checks the quantities required for each job and the totals for the day are transferred to Fig. 4, the amounts being apportioned to each job and duly charged against it.

Figs. 5, 6 and 7, summarize the expense accounts for the month. Each of these sheets is 8½ x 13 inches in the original. Fig. 5 gives the melting and core oven cost for the month and, as a basis of comparison, the expenses of the previous month, the year to date, and the preceding year are given. The manager of the plant following this cost system has little use for any method which deals in generalities and then guesses at a percentage which may or may not meet the requirements of the case. This last is of course entirely dependent upon the degree of accuracy which the man in charge wishes to attain. In this instance the average

Melting and Core Oven Cost for Month of.....

AIR FURNACES.	THIS MONTH		LAST MONTH		TO DATE		LAST YEAR
	Heats / Lbs.		Heats / Lbs.		Heats / Lbs.		Heats / Lbs.
	AMOUNT	AVERAGE	AMOUNT	AVERAGE	AMOUNT	AVERAGE	AVERAGE
Labor Stocking,							
" Charging & Melting							
Fuel,							
Air Furnace Repairs,							
Total,							
Average Cost per Heat,							

CUPOLAS.		Lbs.		Lbs.		Lbs.	Lbs.
	AMOUNT	AVERAGE	AMOUNT	AVERAGE	AMOUNT	AVERAGE	AVERAGE
Labor Stocking,							
" Charging & Melting							
" Engine Room,							
" Slag and Cinder Mill							
Limestone,							
Cupola Fuel,							
Boiler Fuel,							
Cupola Repairs,							
Engine Room Repairs,							
Total,							

CRUCIBLE FURNACE.		Lbs.		Lbs.		Lbs.	Lbs.
	AMOUNT	AVERAGE	AMOUNT	AVERAGE	AMOUNT	AVERAGE	AVERAGE
Labor Charging and Melting,							
Fuel,							
Repairs,							
Total,							

CORE OVENS.							
	AMOUNT		AMOUNT		AMOUNT		
Labor,							
Repairs,							
Fuel,							
Total,							

FIG. 5. MONTHLY OUTLAY FOR MELTING AND CORE OVENS.

is a matter of direct calculation, the number of heats and the weight being given and the amount of labor (obtained from the itemized reports) deduced as an average for each of the products of furnaces, cupolas and crucibles.

The monthly cost sheet is submitted in Fig. 6. This form is arranged on the same general principles as Fig. 5. The total weight of castings is given with the number of pieces showing the average weight per piece. The line given to "Accessory Castings" refers to plates and other castings used in loam and similar work. This introduces an item which in some foundries may be of little or no importance.

COST SHEET for Month of .....

	THIS MONTH		LAST MONTH		TO DATE		LAST YEAR
	No. Pcs. Avg. Lbs.		No. Pcs. Avg. Lbs.		No. Pcs. Avg. Lbs.		No. Pcs. Avg.
	AMOUNT	AVERAGE	AMOUNT	AVERAGE	AMOUNT	AVERAGE	AVERAGE
MATERIAL							
Metal,							
Furnace Loss,							
Bad Casting Loss,							
Melting,							
Gates and Scrap Loss,							
Total,							
DIRECT CHARGES							
Molding Sand,							
Core Sand,							
Brick,							
Accessory Castings,							
Core Oven Cast,							
Total,							
MOLDING AND CLEANING							
Molding Labor,							
Core, "							
Direct "							
Cleaning "							
General "							
Total,							
SPECIAL CHARGES							
Machine Work,							
Defective Loss,							
Special Expense,							
General Charges,							
Total,							
Total Cost,							
Operative Labor,							
Total Hand Account,							

	POUNDS	Per Cent.	POUNDS	Per Cent.	POUNDS	Per Cent.	Per Cent.
Good Castings,	Lbs.		Lbs.		Lbs.		
Furnace Loss,	"		"		"		
Bad Castings,	"		"		"		
Gates and Scrap,	"		"		"		
TOTAL CHARGE,	Lbs.		Lb		Lbs.		

FIG. 6. MONTHLY COST SHEET.

As a general thing the plates are easily and rapidly made, involving a minimum of skilled labor; and usually they are broken up and remelted as requiring less attention than storage and the keeping of such an account of their capabilities as would enable them to be speedily put in service whenever they may be of use. Our manager holds them valuable according to their purpose and charges the actual cost less their scrap value to the job upon which they were used. When it is desirable to retain the casting for use in the future on a new job, the cost is eliminated as they are carried only at the value of scrap iron.

General Charges for Month of

	THIS MONTH. AMOUNT.	LAST MONTH. AMOUNT.	TO DATE. AMOUNT.
Office Expenses.—Salaries.			
Office Expenses.			
Postage, Teleg. and Teleph.			
Advertising.			
Selling Expense.			
Total.			
Sundry Expenses.—Taxes and Insurance.			
Water and Ice.			
Electric Lighting.			
Heating.			
Internal Revenue and Int. and Discount.			
Laboratory.			
Switching.			
Cartage.			
Current Improvement.			
Total.			
Cranes.—Labor.			
Power.			
Crane Repairs.			
Total.			
Carpenter Shop.—Labor.			
Lumber.			
Supplies.			
Total.			
Superintendence.			
General Labor.			
General Repairs.			
Molders Supplies.			
General Supplies.			
Total.			
Total Charges.			

FIG. 7. GENERAL CHARGE SHEET FOR THE MONTH.

The general charges for the month are treated in detail in Fig. 7. No superficial adjustment of the foundry burden is considered worth the while by the man in charge. Here the salaries of all holding positions of responsibility appear with the expenses incurred in marketing the product, handling the accounts, advertising, etc. Here also appears the itemized list of sundry expenses; this last in this case is set forth with sufficient detail to serve a far more useful purpose than the term is often employed to describe. The electrical conveniences, cranes and light, are charged from the meter readings regularly.

It will be seen that the manager of this foundry is not content with ascertaining the cost of any one casting or even a number of pieces. He has devised and applied a system which treats of the foundry and its functions in detail and compares the present and past efficiency of the plant with a careful analysis of the part played by the men and materials in the mechanical operation of the works. He has at command in a tabulated form the work done by each employe; the total amount turned out daily, weekly and monthly; the manufacturing efficiency of the organization as evidenced by the percentage of defective castings, furnace losses, etc. In short, the haphazard plan of estimating on a piece of work is eliminated to a remarkable degree. Of course the new piece of work may be, and frequently is, something entirely different from the usual run of castings; but a close acquaintance with the labor possibilities of the plant through the medium of the present system is of valuable assistance in that event, while in the calculation of work regularly handled it permits a check of surprising accuracy to be kept upon the cost of the output.

Another form, which is not here illustrated, gives the quantity and character of the output of each molder as shown by the weight and number of good or defective castings, as the case may be. This individual record which is easily maintained from the other foundry forms has been useful in different ways—for instance, as a comparative check against the individual labor output. The manager states that in dealing with the men it has been of great value to take out the record book and let the molder see that his work has not been lost to view, but has been constantly and keenly scrutinized by those in charge. There is a natural curiosity to learn how the office record of a workman's labors agrees with the personal impression and the system has occasionally proved well worth the trouble taken with the tabulation.

The cost keeping method as here outlined is maintained in conjunction with a series of excellent forms for shipping and similar purposes. It has seemed best to restrict the present article solely to the matter of cost accounting and in this particular the scope and detail of the system will be worthy of careful investigation. —*The Iron Trade Review.*

The J. L. Mott Iron Works, of New York City, have awarded the contract for their new foundry to be built at Trenton, N. J. This will be 80x475 feet in size.

Cost Keeping in Foundries.

BY BENJAMIN THOMPSON.

I have been much interested in the article describing "A System of Foundry Cost Keeping" appearing in your September issue. The cost of castings is a subject in which nearly every foundryman is interested and naturally the methods adopted by his competitors to determine what this cost is, receives more than ordinary attention.

The actual cost of castings is what a foundryman wants to know. It is really immaterial to him what others set aside for superintendence, insurance, depreciation, etc., because all of these items are known to him as far as his own establishment is concerned, and if not are easily ascertained. In a general way it may be said to be practically impossible to find the exact cost of every little casting which enters a jobbing foundry. While S. F. claims through a card system to be able to ascertain the labor cost of all castings weighing from one-half pound upwards, it is certain that this can not be done except in specialty shops, where the question of shop costs is relatively much easier to handle than it is in a foundry accepting contracts for all classes of castings. That Mr. S. F. does not make many half-pound castings is shown in Fig. 7, where the average weight of castings is shown to be 335 pounds.

If a molder could work on every jobbing casting singly it would be possible to say just what the labor expended thereon amounted to, but as we all know, small patterns in a jobbing shop, the half-pound variety which S. F. mentions, also sometimes called chicken feed, are not handed out singly to the molder nor are they always patterns belonging to the same party. With this class of castings the molder is given as many patterns as he can conveniently handle in one flask, and it is evidently out of the question to say what has been the exact value of the labor expended upon each, no matter what kind of a system one may follow.

For the lighter class of castings the foundryman will find it more convenient to divide these into sections, such as very light bench work, light cored castings, plain uncored castings, etc., and then ascertain the cost per pound of producing each class instead of trying to find the cost of each individual casting, something he can not do in the ordinary jobbing foundry. We all know that it is easy enough to figure out the length of time which has been spent upon a large casting, the rub comes in when one tries to figure out the cost of the smaller cast-

ings after the same fashion. Evidently S. F. only intended the system he describes to apply to the heavier class of castings far beyond the half-pound limit as he says a clerk is sent around to each molder to collect information as to how the time has been occupied by the molder and his helper. This clerk is also to obtain the actual number of hours' work that has been done on a certain job by coremakers, cleaners and chippers. It is plain that unless the casting is one of considerable size the molders and other workmen can not remember the time spent on every little job until the clerk appears to make a note thereof.

It is asking too much of a set of workmen to carry around in their heads the exact time spent on every little casting. The object sought may be partly accomplished by furnishing molders, coremakers and casting cleaners with daily time reports to be filled in by them as they reach one job after another throughout the day, but then in that case it is unnecessary to have a clerk trying to obtain the same information as this can be copied from the reports of each workman.

I do not believe that it is the custom of foundrymen to consider one cent per pound as covering the cost of melted iron outside of the fuel consumed. I do not see how this price can be arbitrarily fixed at this figure when one considers the fluctuations in the cost of pig iron and fuel. If we desire to obtain the actual cost of castings there can be no such a thing as considering this item a fixed charge. Of course any foundryman is at liberty to charge what he pleases for his castings, but what I am trying to show is that the system illustrated does not give anywhere near a true statement of the actual cost of producing castings. Mr. S. F. gives the "actual" cost of producing a cylinder top, or what he probably means, a cylinder head, weighing 9,000 pounds, as being $177.50. Bunching up his figures in a different form I find that he has charged to metal $90.00, labor $29.50, and superintendence and other items $58.00. I believe every practical foundryman will support me in saying that in a well regulated foundry the cost of superintendence, sea coal, sand, etc., is not double the amount expended for labor. In other words Mr. S. F. allows 32.7 per cent for general shop charges when he only allows the total cost of molders, their helpers, coremakers and cleaners 16.6 per cent. From actual contact with foundries I know that contracts for castings are taken within much narrower limits.

This particular cylinder head which is used as an illustration must also have been a most complicated casting since it required three days of the coremakers' time when it only took the molder four days and a half to make the mold, set the cores and cast it. The shop could also not have been using a very good grade of blacking since the chipper worked two days to get it into a fit shape to leave the works.

I object most emphatically against Mr. S. F.'s method of charging up the loss caused by rejected castings. The *actual* loss sustained by a foundryman when a casting is defective is the cost of molding and coremaking, the expense of melting the iron together with the loss of metal in the melting operation, the general shop expense attached to the casting and the cost of breaking up the casting so that it may be remelted. It is the extreme height of absurdity to claim a loss equal to the price at which the casting would have been sold as shown in Fig. 2 of the cost system illustrated for does not the foundryman retain in his possession the iron of which the casting was made?

I do not know whether the blanks shown in the article have been filled in with the idea of doing this just for the fun there was in it, at any rate if any one has a cost system that amounts to anything the less joking there is about it the better the foundryman will like it, as this is not much of a subject to joke about. From the cupola record of Mr. S. F. I take it that on June 10th of this year he melted a heat consisting of two charges of 6,500 pounds each. On the bed consisting of 500 pounds of coal and 350 pounds of coke he melted 6,500 pounds of iron and on the following charge of fuel consisting of 100 pounds of coal and 300 pounds of coke he melted another 6,500 pounds of iron or at the ratio of 1 to 16.25. I am not much of a believer in melting ratios, for generally the man who doesn't care much for what he says can melt the most iron with the least fuel, at the same time to save S. F. the trouble of substantiating these figures with actual facts, vouched for by responsible parties, I should like to have him admit that the ratio which he quotes is simply a joke, or say a dream.

The semi-annual report shown in Fig. 7 may be so complete that it answers all demands, at the same time I am of the opinion that what the majority of foundries are after in the way of a cost system is not something which will inform them twice a year what their foundry expenses amount to, but rather something which will enable them to say what it has cost them to fill a certain order for castings. This the system of S. F. fails to do, and while he may have made a pretty good *guess* at the cost of producing castings, still nothing is surer than that before he shows us how to arrive at the *actual* cost of castings he will have another guess coming.

The Krank's Korner.

As the reader probably knows there has been an eight-hour bill before the congress and senate of the United States for some time, the passage of which has been generally opposed by the manufacturers of the country. Doubtless the bill as proposed may have objectionable features, yet one can not help but wonder at some of the absurd statements put forth by the opponents of the measure. Among such is noted the testimony of a leading manufacturer, who is credited, in referring to some machines his company had built for the government, with saying:

"The castings were made in our foundry, where we employ 600 or 800 men, and it would be impossible for the best foundry foreman to charge his cupolas with just the amount of iron that he would need to fill all his flasks within the eight-hour limit. Under this bill if the eight hours have passed and he still has several tons of metal in his cupola, he must leave it there and let it solidify, after which he must blast out the cupola."

It is too bad that people who know so little about the foundry business should venture to speak for it. The best foremen in the country, and by the way some who are not so good, can run off a heat within a four, six or eight-hour limit, this party's assertion to the contrary notwithstanding. If a shop has not cupolas enough to melt the iron it requires in eight hours, it is just possible that more cupolas could be installed. Again I would suggest that if this iniquitous eight-hour bill should become a law, and the foundry foreman should happen to be caught with some unmelted iron in his cupola at the last minute, the best thing he can do is to shut off the blast and yank the prop from underneath the bottom of the cupola. The next morning the unconsumed coke and pig iron may be returned to the charging scaffold and it will not be necessary to blast out the cupola. As I understand it there is nothing in the proposed law to prohibit a foundryman from dropping the bottom of his cupola inside of the eight-hour limit.

* * * *

The International Foundry Co., with a capital stock of $5,000,000 was recently incorporated under New Jersey laws to acquire and develop certain inventions of Charles P. Szekely relating to the casting of iron in permanent molds. According to reports it is set forth in the charter that Szekely has a secret process, compound, or tincture for smearing the molds by which the iron when cast can be taken out without resorting to the usual practice of breaking the molds.

The question of securing a permanent mold is followed up a good deal like perpetual motion and both belong to the same class. The great obstacle in the way of permanent molds is the unpleasant habit iron has of contracting after it becomes solid. We all know that the majority of castings require to be made in a material which will yield to the contraction of the iron. It is evident that a permanent mold can not yield and retain its shape at the same time. It may perhaps be urged that means can be provided whereby the mold may collapse so to speak, and in this connection it will only be necessary to refer to the designs of collapsible core bars for water and gas pipe, none of which have proven themselves practicable enough to secure an introduction in this branch of the trade.

Many castings are of such a shape that they may be made in chill molds without trouble yet when the cost of making a perfect chill mold is considered the use of these except where chilling of the iron is desired, has made but little progress. As far as a "tincture" for smearing molds is concerned it is likely that for a good many years to come nothing will surpass the stuff which comes from the island of Ceylon under the name of Plumbago.

* * * *

At the same time this five million dollar concern is launched in Jersey to make permanent molds, my friend Fred Baldt, of Chester, Pa., starts in to stir up excitement in the steel branch of the trade by a new molding process, of which the *Iron Age* speaks as follows:

"The steel casting industry, which has made such wonderful strides in this country within the past decade, may be said to be still in its infancy, bright minds in the trade continuing to evolve new and still more wonderful ideas. One who has contributed in no small degree to this advancement is Frederick Baldt, Sr., general manager of the Penn Steel Casting Works, Chester, Pa. Mr. Baldt has discovered many new and important processes that have raised the standard of steel casting to a high point, but that he has not been content to rest upon these laurels won in the past is demonstrated by recent achievements. For months he has been engaged in developing ideas that have resulted in the introduction of a system

of steel molding that promises to revolutionize the process.

"Patents were recently issued to him that will materially simplify the molding of steel. The method consists in first making a master mold from any pattern and then casting from this as many fusible patterns as may be required. This fusible pattern is then put into an iron box of suitable size, after which, by means of compressed air, the box is filled with molding sand. The box is then run into the drying oven, where the fusible pattern is melted out. The casting is then made from the dried mold.

"An important feature of this process is that it does away with skilled labor, the sand being conducted and driven by compressed air into all parts of the box and fusible pattern by either boys or laboring men. Since the castings are absolutely seamless and without fins no chipping is required afterward. The process is also particularly applicable to the casting of chains and similar interlocked articles. By this process it is also practicable to produce articles in exact duplicate and in any number."

This is the *cireperdue* process, which so far has been confined principally to statue founding. At this distance it seems to me it would cost something to make these fusible patterns, besides it would also appear as if several cored castings might give cause for speculation. Then again if all skilled labor is done away with and the sand conducted and driven by compressed air into all parts of the box and fusible pattern by boys and laboring men, might not the fusible pattern be slightly marred? Of course there will be no fins on castings made after this method as there are no joints to the mold, at the same time the outlets for the fusible material would leave some chipping to be done. Perhaps these fusible patterns would also be liable to get out of shape pretty easy. All in all it takes considerable time to develop revolutionary processes and it will be well enough for foundries of all kinds to hang on to their molders for a few days yet. It was prophesied that the molding machines would dispense with the molders' services, still it seems as if they have actually increased the demand for skilled mechanics.

* * * *

In a paper dealing with "Foundry Accounting," presented at the Boston meeting of the A. F. A., Mr. J. G. Stewart offers the following advice under the head of "New Hands:"

"When molders and coremakers are being started, it would be a good thing if the foremen were to enquire whether the men have their outfit with them, (that is to say a trowel, cleaner, a 2 foot rule and a hand hammer; and in the case of a loam molder a rat tail blackwash brush). This precaution would prevent a great deal of time being wasted by men perhaps going all around a shop to borrow something or other with which they ought to have provided themselves before seeking to start work in a new shop, and would no doubt be the means of the men taking more pride and interest in their work. This is perhaps a trifle at sight, but it adds considerable to the cost account to have to pay a man a few half hours looking for the ordinary tools of his trade. In addition he disturbs and annoys his fellows by his queries."

It might also be a good thing for a molder when he engages himself to ask the foreman if he will be supplied with a swab-pot, riddles, brushes, a shovel, rammer, etc.; whether the shop has a sufficient supply of gaggers, gatepins, facing-sand and other things which it should provide. It is very provoking for a mechanic to have to spend his time looking up tools which should be handed him at the start. The time he thus spends may seem small but it keeps him from getting up his day's work on time.

The Blake Roll-Over Molding Machine.

That one type of molding machines is not suitable for all classes of castings is shown in the variety of designs which are in use, each giving satisfaction in its own field. As a rule it will be found that shops which have had the smallest measure of success with molding machines have been such establishments as have neglected to recognize the fact that nearly every job has peculiarities of its own for which provision must be made, if the best results are to be attained.

Every molding machine, no matter how perfect its mechanism, requires a certain amount of skill from the operator. The often repeated claim that "any laborer can handle a molding machine" is only partially true. Probably an intelligent laborer can operate certain molding machines with satisfaction to all concerned after a rather brief course of instruction, as he can learn to make one casting on the bench or floor in a few weeks, yet when he reaches this stage he ceases to be a common laborer and must be regarded as a more or less skilled

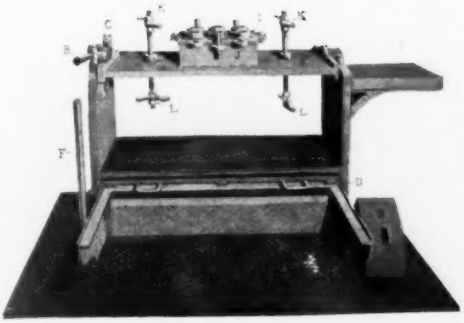


FIG. 1. THE BLAKE ROLL-OVER MOLDING MACHINE.

workman according to the proficiency he develops.

The Geo. F. Blake Manufacturing Co., employ in their foundries at East Cambridge, Mass., a molding machine of somewhat simple design, which is credited with turning out accurate work very rapidly. It is known as the Blake Roll-Over Molding Machine and is designed to draw the pattern, but not to ram the mold, as experience has demonstrated to the manufacturers that while automatic peening and ramming may be done in slightly less time

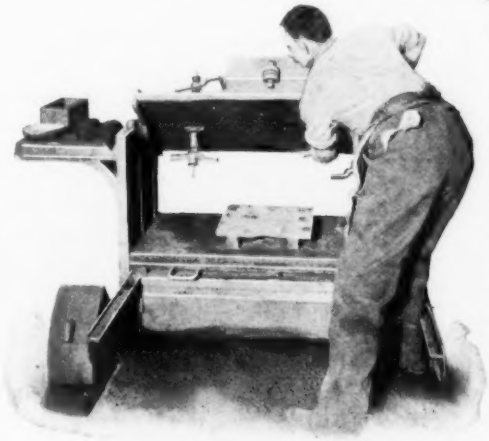


FIG. 2. REVERSING THE TABLE AND FLASK.

than will be occupied in doing the same work by hand, the losses from bad castings are greater than with hand ramming. At the present time the Blake molding machine is built in one size only, this being capable of handling flasks from 10" x 10" x 2½" deep to 30" x 18" x 10" deep. Ordinary patterns and flasks may be used with this machine, the only requirement being that the flasks be interchangeable. The essential parts of the Blake molding machine may be placed in three divisions as follows: (1.) The roll-over table A, Fig. 1, swinging on trunnions in the side frames and capable of being securely locked in an upright or reversed position by clamps B or C respectively; (2.) The elevating table D, which is counterbalanced by the weight E, and may be easily raised or lowered by the handle F through a simple system of levers located in the pit underneath the machine; (3.) The receiving table G, which rests on the elevating

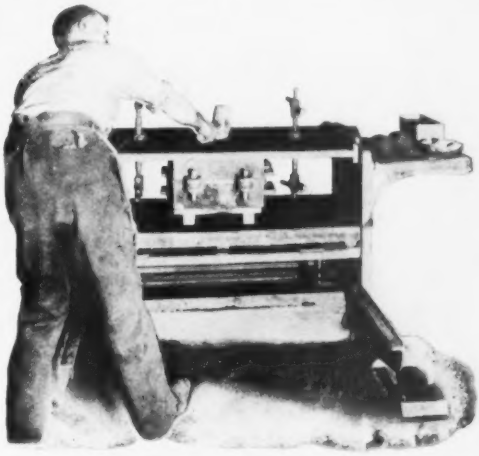


FIG. 3. REMOVING PATTERN BY LOWERING ELEVATING TABLE.

table and can be drawn out on the tracks as in Fig. 5 to facilitate the removal of the mold from the machine.

In the machine shown in Fig. 1 the pattern plate I is attached to the box J, the latter in turn being bolted to the roll-over plate. It should be stated that in this instance a convenient number of drags are first rammed up and afterwards an equal number of copes, the patterns being so arranged that the molder may reverse these at will. When either part of the flask has been placed upon the pattern plate it is locked tightly in place by the dogs K, these

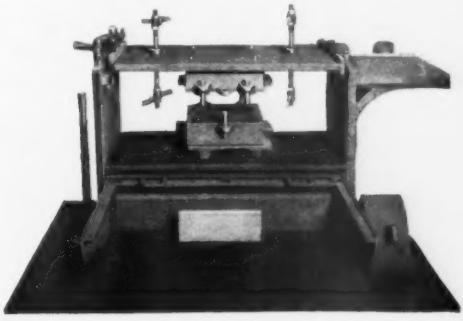


FIG. 4. PATTERN SEPARATED FROM MOLD.

as well as the dogs L being clamped to the vertical rods M, but adjustable to suit the height of different flasks. When the drag or cope has been rammed up the clamp B is loosened, the roll-over table reversed and locked in its new position by the clamp C. Fig. 2 shows the molder in the act of reversing the table after which the elevating table carrying the bottom board (the board is *not* placed on the drag before this is rolled over) is raised by means of the lever F until it strikes the flask as shown in Fig. 3, when the dogs K are

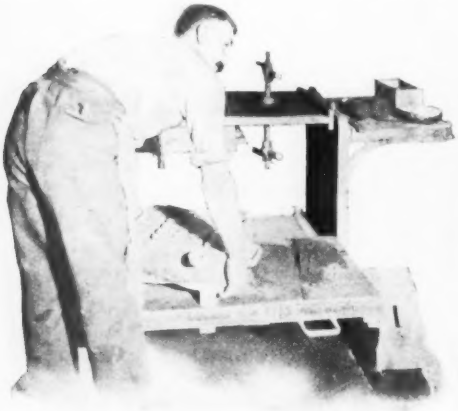


FIG. 5. RECEIVING TABLE EXTENDED TO FACILITATE REMOVAL OF MOLD.

loosened by striking the dogs L, thus freeing the flask from the pattern plate. At this stage the molder taps the roll-over table with a wooden mallet, at the same time gently lowering the receiving table, which carries the flask with it and thus removes the mold from the pattern, Fig. 4, instead of the pattern from the mold as is the case with the majority of molding machines. When the receiving table reaches its normal position it is together with the mold pulled out on the tracks, Fig. 5, and the mold removed to its place on the floor after which the operation is repeated.

The Laidlaw-Dunn-Gordon Co. are adding a new brass foundry to their plant at Cincinnati, O.

The Michigan Foundry Co., of Kalamazoo, Mich., have been organized by George Polasky, Frederick J. Bremer and Godfrey J. Bremer. The company is incorporated for $20,000 and takes over the business of the Bremer Machine Co. The manufacture of gasoline and steam engines is the principal business of the concern.

Flasks for Molding Machines.*

BY S. H. STUPAKOFF.

Talk to a foundryman about flasks and you touch a sore spot, and no wonder, for flasks are a continual drain on the exchequer. Founders will tell you that if it were not for the cost of flasks, there might be some profit in the business. They admit that they are a necessity, but invariably think them an unavoidable nuisance, a source of constant annoyance, loss, and expense, and in fact the greatest evil of the foundry. It is often thought that every cent spent on the construction and maintenance of flasks is just so much money thrown into the gutter.

S. H. STUPAKOFF.

But luckily, all the opinions on this subject do not run in the same direction. There are many founders who have gone through it, who hold and prove that bad flasks give bad results, are false economy, and point to poor judgment. They argue, and justly so, that money spent judiciously for a good flask equipment, especially for a good set of stock flasks, and a liberal sum set aside and used for their maintenance, is a good investment. An expenditure of this kind is mainly a matter of first cost, and is fully justified by the results.

The founder who knows a good thing when he sees it, will also know how to take care of it. He will not permit his flasks to be abused and thrown out into the yard where they are exposed to the deteriorating effects of the weather. He will keep them under roof and guard them against all possible damage. Nobody will question the fact that bad flasks are more than likely the principal cause of loss of time and of castings. Yet how many are there who will anxiously try to save and stint in this direction? Give your molder good material, good facilities, and above all let him have good flasks, and you have a right

*From a paper prepared for the Boston meeting of the A. F. A.

to expect a good day's work, and that of good quality.

Good flasks are especially important in machine or plate molding. In fact, to insure good results from molding machines, the flasks used must be practically perfect. They should be constructed so as to insure a firm holding of the molding sand. They should be made stiff, light, and durable. The flask pins should be accurately fitted. If flasks are made in sets, they must be absolutely interchangeable. When copes and drags are put together they should not rock or shake sideways. The pins should be firm and square with the flask surface; and while they must not bind, on the other hand they must not fit too loosely.

Ordinary shop-made wooden flasks, such as are used in most foundries, are not likely to give good results in molding machine practice, but if carefully and substantially made, and perfect in all other respects, there is no reason why their application in machine molding should be absolutely condemned.

Iron flasks are always preferable, more especially because they do not shrink, warp, or get out of joint. Pressed steel flasks, if they could be procured, would answer still better. If wooden flasks are used, they should be provided with an iron ring, at their face, which ring should serve not only as a tie and alignment, but also as a base for securing the flask pins.

Turned tapering flask pins give the best satisfaction in flasks for machine molding. Part of the pin is usually turned down to a square shoulder with a thread at its lower end, the cylindrical portion is fitted into a corresponding hole in the flask lug and permanently secured thereto by a nut. A better way is to ream tapering holes in the flask lugs, make the lower ends of the pins accordingly and drive them lightly into place. Thus, a few pins will answer for any number of flasks, as they can be removed as soon as the flasks are closed and clamped together. Greater care can thus be bestowed upon their production, as the increased cost is but a small item, and when not in use they can be easily removed from their sockets and bolts, flasks and pins can be easily and properly taken care of.

A convenient way to remove such taper shank pins is shown in Fig. 1. A piece of flat iron or a flask clamp is used as a lever by placing it between the lower end of the taper shank and the rounded top edge of a fulcrum lug, which may form a part of the side of the flask, and which should be located one or two inches out of alignment with regard to the center line of the flask pin. A prolongation of these lugs may also form the handle of the flask. A slight pressure or a light tap with the hammer will loosen the pins from their sockets, whereupon they may be easily withdrawn. The B. & S. Standard is recommended as the most suitable taper for these taper shank flask pins. Accurate reamers are always obtainable in exact duplicates, and their use insures absolute uniformity.

It may not be out of place to caution against the maltreatment of the ends of these flask pins, which is bound to cause trouble and annoyance. There is not much likelihood to injure the pins if mallets of either rawhide, wood, lead or copper are used for driving them in or out. As an additional precaution, to protect them from injury it is desirable to have them case-hardened. Care should be taken that the flask pins do not spring or bend during the hardening process, if they do, this fault should be corrected before they go into service, for bent or sprung pins are unfit for use. Little or no trouble will be experienced with good tool steel pins.

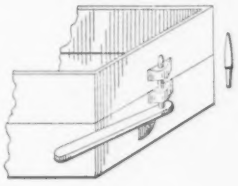


FIG. 1.

FIG. 2.

It is common practice to arrange the flask pin lugs in such a manner that a space of about a quarter of an inch or more is left between them when the flask is closed. Thus, no attention need be paid to the small quantity of molding sand, which inadvertently collects and packs around the base of the pins while the flask is being filled, but which would otherwise form an obstruction in the closing up of the flask. These spillings must be removed if the faces of the lugs are on a level with the parting edge of the flask.

It is sometimes troublesome to close or open flasks which are provided with well-fitting round flask pins, as molding sand or dust will unavoidably adhere to them. This difficulty may be overcome to a great extent by removing a portion of the cylindrical part of the

pin by either flattening or grooving as shown in the cross section, Fig. 2.

Constant use of flasks of this kind will eventually wear out not only the flask pins, but also the sockets of their corresponding mates. They cannot possibly be kept absolutely clean, and the sand will keep on cutting until the defect must be remedied. It is an easy matter to exchange the worn out pin for a new one, but is not so easy to correct the fault in the flask pin socket, unless, indeed, it was provided with a removable bushing in the first place. This, when necessary, can be replaced with the same facility as the pin. This is a point but rarely observed. To get perfectly satisfactory service out of a flask, it is nevertheless quite as important a matter as all the others which were mentioned above.

The makers of molding machines are undoubtedly very well aware of all the requirements, which are covered by the observance of these little details; they will appreciate their importance and must admit that they are essential to make their machines a success. Yet, to my knowledge these facts have never been mentioned. Is this information kept from the founder purposely, that he may not be scared from the purchase of machines? If he should be told all this he might in the first place think of the expense, and next that his molders cannot get used to refinements of this kind—which, by the way, is not a very creditable opinion. But, if he buys one or more of the machines offered he cannot help finding all this out before long, to his own chagrin. By that time, perhaps, he has made up his mind to throw the thing in the scrap pile, or, if he persists, because he knows that others have succeeded, he will be compelled to pay dearly for his experience. He could have had this experience in the first place, and at a reasonable price, had he been furnished not only with the machine, but at the same time with jigs, sample flasks, pins, etc., and above all with necessary information to which he was justly entitled.

It should be taken into consideration, that not all founders, foremen and molders are expert engineers or machinists, nor can they be expected to be fully versed in all the intricacies of machine design, mechanical laws and movements. To convince them, and to demonstrate that machine molding is superior in every respect and more economical than the process of hand molding, in which line they themselves are experts, they need all available assistance and must be taught from the very beginning the principles of the construction of the machines, the scope of their utility, their application and the importance of accessories, and the essential parts in all minor details. Many failures to introduce the molding machine into foundries, to establish and to maintain their reputation as labor savers can be traced to the lack of intelligible instructions sent with them by their makers, and be it intention or neglect, the withholding of this information does more or less harm to all parties interested.

Pneumatic Ramming.

At various times we have illustrated in these columns types of pneumatic rammers, intended to take away from the molder the laborious part of his trade, that of "pounding sand." Except where extreme delicacy is required, as in ramming pockets and green sand cores in general, there does not seem to be any valid reason why mechanical means for compressing sand should not be employed. There is certainly no demand for the real skill of the molder in ramming up a loam pit, or a large flask, after the first course of sand has been attended to, as it is simply a question to give the sand sufficient solidity to withstand the pressure put upon the mold when being filled with metal. Even on those parts of the mold where skillful ramming is required a power rammer in the hands of the molder should prove an instrument of usefulness and relieve him of enough hard labor to leave him in better condition for more important work, where his experience and skill as a mechanic counts. As to the performance of pneumatic rammers it is interesting to note the following statements in a paper read at a recent meeting of the Philadelphia Foundrymen's Association by Adam C. Harper, of the Philadelphia Pneumatic Tool Co.:

"At the Builders' Iron Foundry, Providence, R. I., a cope 19 feet by 7 feet, 15 inches deep, was rammed up in one hour and thirty minutes. Mr. Alex McGregor, the foreman, said he would be satisfied if a man and two helpers could ram up the same in eight hours, as this was a considerable reduction in the usual working time on this casting. At the Warren Foundry & Machine Co., Phillipsburg, N. J., a cope 6 feet by 6 feet and 8 inches deep, was rammed up in eight minutes, the foreman in charge of this shop admitting that he could not ram

it up in less than 30 to 40 minutes. Our next proposition in the same shop was a cope 15 feet long, 2 feet 6 inches wide and 16 inches deep. We rammed it up in 27 minutes, while it takes a molder and two helpers two hours to complete the same. At the A. S. Cameron Steam Pump Works, New York City, a cope 6 feet by 3 feet and 6 inches deep, was rammed up in three minutes against twenty minutes by hand. At Wm. Sellers & Co., a very peculiar piece was rammed up by us in three hours, while it takes their leading molder nine hours. At Cramps' shipyard two rammers in a pit do the work of 30 men, in shorter time than hand ramming, and they never use curbings any more below the level of the floor, as the ramming by this process is hard enough. The Pusey & Jones Co., Wilmington, Del., some time ago, rammed up a paper dryer mold 15 feet long on end, in seven hours with three helpers against five molders and five helpers in five hours, or, in other words, 28 hours was the time for two rammers and three helpers as against 50 hours for five molders and five helpers with the hand system of ramming. Many tests have been made at the Bethlehem Steel Co. on armor plates, where they are now prepared to do with two of these rammers and four helpers, six men in all, in 14 hours each, what ten men can do on the same work in 30 hours each."

Cast Iron.*

BY PERCY LONGMUIR.

Generally speaking, cast iron may be regarded as metallic iron, associated with varying amounts of carbon, the content of which is seldom lower than 2 per cent. In addition to carbon there are always greater or less amounts of silicon, mangenese, sulphur and phosphorus present in every variety of cast iron.

Other things being equal the mechanical properties of any variety of cast iron depend upon the amount of these constituents and the relationship they bear to each other. This combination may be such as to favor the production of a high quality iron, or it may be such as to produce one that is poor. High and low quality are terms of convenience rather than of exactitude, as every iron produced is applicable to some definite purpose for which its quality may be regarded as good.

*Abstract from a paper prepared for the Boston Convention of the A. F. A.

In reviewing the constituent elements of cast iron the foremost and most important in effect is that of carbon. Though it can hardly be said that the presence of any one element definitely rules the quality of cast iron, yet this element closely approaches this position. In a large measure it is the amount of carbon present in any iron that determines its quality and the purpose to which it is adapted. With average grades of cast iron the total carbon present varies between 2 and 4.5 per cent. This latter amount is exceeded in certain alloys such as ferro-manganese or ferro-chrome, but these are instances distinct from the cast irons. The actual occurrence or mode of existence of carbon in iron is to some extent a controversial matter. To the founder, however, who must necessarily keep on the practical side of science, carbon is known in two conditions, these are as free carbon or graphite, and combined carbon or iron and carbon in a state of definite chemical combination.

PERCY LONGMUIR.

Cast iron, whilst fairly strong in compression, is weak in tension. Apart from other contributory causes this low tenacity may, to some extent, be explained by the distribution of the free carbon which is familiarly shown in a fractured sample of pig iron. The flakes of graphite or free carbon when the cast iron is in tension, act as isolating media, and a series of these little cuts, as it were, offer a convenient route along which fracture may readily travel. With a compressive force these conditions are not so evident and consequently cast iron is well adapted to resist crushing forces. Naturally a high content of free carbon denotes a soft iron, but it is the amount of combined carbon that regulates the quality of any iron and determines its suitability to meet any specific purpose. Recognizing combined carbon as the controlling factor we find that 0.10 per cent of combined carbon gives a dead soft iron; 0.20 per cent a soft iron; 0.50 per cent an iron of the highest

tensile strength and 0.70 per cent a metal of the highest transverse strength.

These figures relate of course to irons of normal qualities. The difficulties in fixing exact carbon standards for cast irons are great, owing to the complex character of the metal and the high content of elements other than iron.

From carbon to sulphur is a fairly natural step owing to a relationship often found between these two elements in a series of ascending irons produced from a similar grade of ore. Sulphurous irons, apart from other drawbacks, are generally speaking "hard." This hardness and the relationship just spoken of may be found in the fact that high sulphur usually accompany high combined carbon.

When producing iron in the blast furnace the lower temperatures favor the production of sulphurous irons, high in combined carbon and correspondingly "hard" or "white." These conditions are intensified if the slag be strongly acid, and are restricted if much manganese be present, sulphur in the latter case combining with the manganese, forming a slag of manganous sulphide. These conditions are interesting to founders in that the cupola furnace bears a certain analogy to the blast furnace.

With the cupola slow melting, accompanied by a low temperature, yields conditions which favor the taking up of more sulphur from the coke than is the case with quick working at high temperatures. In one instance which came under the writer's observation the first melting showed the iron to have a sulphur content of 0.04 per cent, the second 0.10 per cent which was increased to 0.20 per cent in the third remelting. Needless to say this is not claimed to represent first-class melting practice.

Phosphorus appears to have little effect on the combined carbon, and in a series of ascending irons this element usually remains fairly constant. To some extent it lightens the appearance of a fracture and has a slight hardening effect on the iron with which it is associated. From a foundry point of view phosphorus is not nearly so harmful as sulphur, and is less of an evil to the iron founder than the steel maker. Phosphorus in cast iron promotes soundness, increases fluidity, and with it the capacity for taking and retaining the sharpest details of a mold. Castings such as machine details, gearing and the like, which have a fair amount of shock to resist, may contain up to .5 per cent phosphorus. However the general run of castings may contain up to 1.5 per cent, but higher percentages than this are only advisable for castings in which strength is immaterial.

Manganese increases the capacity of an iron for carrying carbon and by permitting the formation of double carbides of iron and manganese increases the hardness according to the content present. This hardening effect is, however, neutralized in the presence of high silicon.

Iron and manganese combine in proportions up to 80 per cent of the latter, the product being the familiar ferro-manganese. With lower amounts of manganese, that is, between 12 and 20 per cent the product is known as "spiegel" or "spiegeleisen."

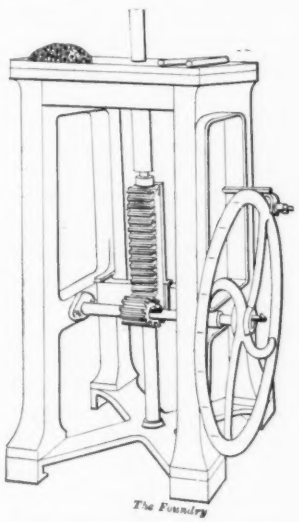
Manganiferous pig irons are specially useful in foundry practice for mixing with others contaminated with an excess of sulphur. In this manner manganese may act as a softener, that is by effecting the removal of sulphur. Generally manganese increases the hardness and closes the grain, and hence is valuable in castings that have to be finished up dead smooth. With an iron in which silicon and sulphur are normal from 1 to 1.50 per cent, manganese will do all that is desired. Of this quantity a certain amount will be oxidized, which, varying with furnace conditions may reach a total of 40 per cent.

Silicon is present in every variety of cast iron, and owing to its effect on the formation of combined carbon has been conveniently regarded as a ready means of controlling the quality of an iron. Silicon acts indirectly as a "softener" by producing conditions which favor the precipitation of carbon in the graphitic form and other things being equal results in an iron, the softness of which depends upon the extent of this precipitation. Hence the silicon contents of various irons offer ready means for the adjustment of mixtures, and consequently there have arisen silicon standards. In general practice these standards cover the percentages of silicon from 0.5 to 2.5, ranging from castings such as cylinders and valve bodies down to soft castings, pulleys and the like. Investigations as to the influence of silicon upon cast iron show that the maximum hardness is reached with silicon at 0.60 per cent; crushing strength, 0.80 per cent; density in mass, 1.00 per cent, tensile strength, 1.80 per cent; softness and general working qualities, 2.50 per cent. For general

purposes a mixture figured on the content of silicon alone will give a reliable result, but it must be remembered that silicon acts indirectly, and that it is the combined carbon that rules the destiny of any iron.

An English Core Machine.

A machine intended for a larger class of cores than can be made on what is known as "sausage" machines is being placed on the market by J. W. & C. J. Phillips, of London, England. Not only will this machine make cores which are of uniform dimensions throughout their length but by the use of filling pieces, pushed out with the core and then lifted away, a much more complicated class of cores is within its range.



THE PHILLIPS CORE MACHINE.

The Phillips core machine is provided with an iron table, having at its center a recess about 16 inches in diameter, which receives the flange of the core mold or die it is proposed to use. Each mold has a disc which is attached to the rack and when the core is rammed up this forces the core to the table level by means of the hand wheel. The latter has a graduated rim by which the length of the core may be regulated automatically. With this machine cores from ⅜ to 12 inches in diameter may be made.

The Bodley Wagon Co. have removed their plant from Staunton, Va., to Memphis, Tenn.

The Tioga Foundry Co., of Philadelphia, will build a 50-foot extension to their plant.

"Burning" Brass on Iron.

Breakdowns and mishaps are unavoidable incidents in the shipping world; ships are frequently at the mercy of the elements, and the foundries in prominent seaports must be prepared to have all sorts of unusual repair jobs brought to their doors. Burning new tips on cast iron propeller blades is one and burning cast iron machine parts *with brass* is another of such jobs which it has often been my duty to accomplish. To give an instance of the latter: A ship came into port with the bottom eaten clean out of the sanitary pump. It was cast iron, and the engineer wanted to know if it could be burned or patched to last for three months or so, until a new one could be shipped out from the makers. The pump was double acting and close ended, and the bottom end of both barrels was a mass of rust,—a tap from the hammer put daylight into it. Owing to varying thicknesses and diameters, brackets, weak construction and "perished" metal, to attempt to burn this with cast iron was to court failure therefore it was decided that the only possible way of saving the casting and the ship's record for punctuality, was to burn it with brass. The pump was fired to dry off all the moisture and burn out the oil; it was then filled up carefully with sand and put into the oven to thoroughly dry the core. It was taken out hot, the parts to be burned made up in the usual way and burned with soft brass. That was nine months ago and from recent accounts, the burned parts are likely to last as many years.

This is a typical example of the utility of burning cast iron with brass; but for the sake of indicating how this idea can be applied to the more familiar aspects of foundry practice, I will give another example, which is very common.

A cylinder was cast and nearly all machined when a hole was discovered in the barrel near one of the ports. Evidently a corner had broken off one of the branch cores and lodged there while it was being cast. There was no possibility of plugging this hole, and to burn it was a big risk, besides, although it was possible to pour metal on the place, there was not room inside the casting to hold sufficient iron to burn it. It may seem a ridiculous thing to some people to say that *iron can be burned with a less quantity of metal if bronze is used, than would be required if iron was used,* and it is not generally known that iron can be burned with brass

with greater safety and in many cases with greater economy than with cast iron. Nevertheless this is perfectly true and the principles involved have been taken advantage of in several noteworthy patents, such as Goldsmidt's process of generating heat by means of aluminum in the presence of an oxide, or Dick's process of combining iron chemically in brass. The cylinder referred to was burned with brass and turned out a splendid job. The mixture used was composed of copper 16 parts, yellow metal 6 parts, lead 3 parts, tin 1 part. This metal is very fluid, searching, soft, easily tooled and will rivet. For burning iron it should be "jumping" hot.

Sometimes an intricate casting is spoiled in the machine shop through having a hole bored out of truth, or too large. Burning such a job with brass will make it easier to finish and re-bore, than if it was burned with iron. As a rule an alloy melts at a lower temperature than the mean proportion of the component metals, by pouring brass on iron till it melts, a compound is formed which melts at a much lower temperature than iron. The contraction of brass is a trifle greater than that of iron, but the difference is of little account in burning, and all in favor of brass as the burning agent.

Burning is only an expedient, but it is probably the most difficult branch of the molders' art and one in which a great deal more interest might be taken. I think I hear some one say, "Anybody can make up a burn." Quite so; but anybody can't reason out what will happen after the burn is made up. In most burning jobs there are generally a variety of contingencies to be guarded against. To study the heat required on the job, the contraction and expansion of the casting and when to make an "open" burn or a "molded" burn, is not so simple as some people imagine.

Burning iron with brass does not abolish these difficulties, it only mitigates them, at the same time it is of special interest, inasmuch as two metals with little affinity are joined by means of the least refractory of the two. The only disadvantage of the process is that a certain (or rather uncertain) amount of iron gets into the brass used, which renders it useless for some classes of work, such as work required to specification, or work in which an admixture of iron might be harmful.

The so-called fillers are the bane of the foundryman, and no self-respecting molder would care to own that they are indispensable in the foundry; but every tradesman must recognize that burning is an art of the utmost convenience, and worthy of study. I will close with an incident in my experience which illustrates what I have said. An engineer who had been supplied with several "filled" castings, sent for the foreman molder to find fault. "What have you filled this with?" he asked, pointing to a large patch. "A 'filler,' sir, nineteen times stronger than iron," was the reply. "All right, take these back and send me castings either all filler or all iron." The rebuff was well merited, but the lesson was lost on this foreman, for he reckoned he had a specialty in the filler and he swore by it.

JOHN F. BUCHANAN.

An Evening School for Apprentices.

Various schemes have been suggested for educating foundry managers and the improvement of molders in general. It seems to me as if the best way would be to start in at the bottom and educate the material from which molders and foundry managers are made, to-wit: the boys who enter the shop with little or no education. This really may be through no fault of their own, as we all know that the majority of those who become apprentices in the foundry as a general rule are forced to begin work early in life. The environment and general conditions existing in the foundry under our present system of getting all the labor possible out of everyone soon causes the boy to forget nearly everything he has learned at school. When his apprenticeship is completed he is forced to get along the best way he can, and while this is pretty tough it seems to me as if this system is not of much benefit to the foundryman.

The well known printing press manufacturers, R. Hoe & Co., of New York City, have in vogue an apprenticeship system which tends to produce intelligent mechanics and I feel that if the members of our foundrymen's associations would enforce similar rules in their shops they would soon have a better set of workmen, and it would also tend to promote a better feeling between the employer and employes.

In order that the reader may become better acquainted with the system prevailing at the plant of R. Hoe & Co. we reproduce a form of application for apprentices, following this with the contract signed between the company and the apprentice, and the rules and regulations governing the latter.

APPRENTICE'S APPLICATION.

What trade do you wish to learn?.....
What is your full name?.....
What is your address?.....
When were or will you be 16 years old?....
How long have you been out of school?.....
What school did you attend?.....
While at school, how far did you get in arithmetic? .....
What and where was your last situation?.....
How long had you been there and why not there now?.....
What is your parents' full name? (If parents are not living, state name of guardian.) .....
What is or was father's business?.....
Applicant accepted, ...
Department sent to, ...
Date of apprenticeship, ...
Left or discharged, ...
Reason, ...
Out of time, ...
Wages when out of time, ...
Rating: Shop, ...
School .....

APPRENTICE'S ENGAGEMENT.

New York,.....190..

The undersigned,....., with the consent and approbation of his parents or guardian, parties to this agreement, in consideration of the sum of One Dollar paid to him, the receipt of which is hereby acknowledged, agrees and binds himself to serve a full term of five years' apprenticeship with R. Hoe & Co., Printing Press Manufacturers, 504-520 Grand Street, New York, receiving weekly wages as follows:

For the first six months.....	$2.50
For the second six months.....	3.00
For the second year.....	3.50
For the third year.....	4.50
For the fourth year.....	5.50
For the fifth year.....	7.00

Three hundred and five days are to constitute a year's work.

He agrees to perform his duties with fidelity and punctuality and to conform to all rules and regulations of the firm and as printed on the third page of this Agreement.

R. Hoe & Co. agree to give him every opportunity to learn the trade of.....and the advantages of their night school, without charge.

The apprentice,....., agrees to attend this school, as required by R. Hoe & Co.

At the end of the fifth year a diploma will be awarded to him by R. Hoe & Co., stating that he has served the full term of apprenticeship and giving his status as a workman.

The right is reserved by R. Hoe & Co. to cancel this agreement, and discharge the said .....for cause, either carelessness, disobedience of orders, unsteadiness or inefficiency, and it is understood that in this case no obligation is incurred by R. Hoe & Co. toward the said apprentice.

Apprentice's Signature.....
Address.....
Age.....

Witnesses:
.....
.....

We (I).....[parents or guardian], agree that our son or ward, shall serve the firm of R. Hoe & Co. upon the terms specified above.

Witness my hand and seal this.....day of.....190..

.....
.....
(Signatures of parents or guardian.)

RULES AND REGULATIONS.

No apprentice will be employed who is less than sixteen or more than eighteen years of age. He must be physically sound, of good moral character, and have attended school at least four years. He must be accompanied by his parents or guardian, who shall sign this agreement with him.

The term of trial is thirty days, for which he shall receive no compensation. If, after trial, he proves satisfactory, then his apprenticeship shall commence, and continue for five years, unless sooner terminated by the firm.

He shall obey his foreman.

A rating shall be kept by each foreman, and any apprentice receiving for efficiency and deportment a rating of ninety-five per cent, out of one hundred per cent shall be allowed two weeks, with pay, in each year, which may be deducted from his term of apprenticeship, or taken as a vacation.

If he performs his duty with fidelity and punctuality, he shall fully participate in the piece-work earnings of his gang but if he should fail to do so, his foreman may charge 50 cents per week against him, to be deducted from the piece-work earnings, which shall be held by the firm, to be paid as a bonus to the ten apprentices (apportioned equally) who

make the highest rating, at the termination of their apprenticeship. The division of this fund, should there be any, will be made in January to the apprentices having finished their term during the previous year.

When an apprentice, either through carelessness or disobedience of orders breaks a tool or spoils work, the firm reserves the right to charge against him such time and impose such penalty as in its discretion may seem just and proper.

He shall make up all lost time, and no new year of service shall commence until he shall have worked a full twelve months, which shall not include lost time or time charged against him the preceding year.

The use of tobacco and spirituous liquors on the premises is strictly forbidden.

Before an apprentice is discharged, for cause, his parents shall be duly notified and given a chance to show cause why he should not be discharged.

It will be noted from the above that the attendance of the apprentice at the company's night school is compulsory. There are about 300 apprentices in the employ of R. Hoe & Co. and these are the only pupils of the school. To a certain extent their proficiency in this department is considered a criterion of their general fitness to become first-class mechanics. Prizes are offered to those making the best showing; at the annual commencement exercises held a short while ago, prizes consisting of a gold watch, books, mechanical, measuring and drawing instruments were awarded to the boys in each class who secured the highest percentages. Besides the head master, the school is presided over by four teachers and the course which is divided into six classes comprises freehand and mechanical drawing, English, mathematics and mechanics.

The apprentices quit their daily work at 5 o'clock, when they wash up and eat a light meal provided by the company. School begins at 5:30 and lasts until 7 p. m. The members of the "A," or highest class, receive individual instruction. The plan upon which the school has been conducted has been in operation for several years and has fully met the expectation of its founders. Among the apprentices it is considered something of a disgrace for one to lose standing in his school work. In a general way the result of this system has been the building up of a staff of employes that is efficient and loyal. My own experience in handling foundry apprentices convinces me that much good can be accomplished if the boys who come into the shop to learn the trade are afforded a chance to pick up the knowledge which they need. With a compulsory evening school nearly every employer of labor will find it within his reach to train a class of workmen of which he will be proud. S. F.

Foundry Accounting.*

BY J. G. STEWART.

Cost accounts and the important part they play in the success or failure of a business, do not always receive the consideration they are entitled to, but are looked upon as a conglomeration of figures and often not worth the paper on which they are detailed. In fact the idea prevails with some men, to quote from actual experience, "that a concern which will not stand mismanagement is not worth tackling."

J. G. STEWART.

To every business man in the foundry line it will be apparent that he should become familiar with the commercial as well as the practical branch of his business, and as a great deal of his success depends upon close attention to detail, he very soon realizes the importance of the cost department. Here is the key to a financial success, and to a large extent the prosperity or failure of a firm is traceable to the importance they attach to the question of cost accounts.

There are many, I am sorry to say, who do not pay any attention to the cost of production, but go on in a slipshod way, until they find themselves gradually ousted from the place they once held, owing to their lack of business ability. There are a few who have striven hard to keep afloat by close attention to business, but have failed through lack of capital. These cases are few, however, in comparison with those that have had the means at their disposal and have yet failed.

*Abstract from a paper prepared for the Boston meeting of the A. F. A.

The economical and successful working of a foundry plant is the result of close watching. The purchasing of materials in the right market and at the proper time, watching the market reports, exercising judgment and buying accordingly; the practical, theoretical, and technical education and business ability of the management, the accuracy of the estimating and costing department, the co-operation of the officials, foremen and workmen, all tend to the success of an undertaking.

The cost department is essential for the successful working of a manufacturing business. It is possible in a properly managed shop for the cost of every article to be detailed and tabulated, from the small castings of a few ounces to the monster pieces weighing 30 or more tons.

With the right man at the head of the cost department, who is thoroughly acquainted with the requirements of a foundry, working amicably with the heads of the molding shop, information can be readily obtained and accurately tabulated.

If the principal of cost-keeping was better understood we should have fewer cases of failure to report. Huge successes probably would not be heard of so often, as a keener competition would result and it would then be a question of quality and workmanship plus influence, rather than price that would secure the largest share of work.

It will be difficult to lay down hard and fast rules to be followed by firms, big and little, but the system suitable to a large concern can be so modified as to be applicable to a smaller one.

To enable us to compete favorably in the open market we must see that our shop is well placed, well equipped with modern labor-saving appliances; comfortably warm and light in winter, and well ventilated in summer, facility for handling traffic by rail, road or water; the means for storage of boxes, loam plates, etc., with due consideration to available land for extension. Good management, and an expert and efficient office-staff, and the reward of success is certain.

Having arranged the location and equipment of the foundry we turn our attention to the question of a foundry manager in whom should be vested power to enquire into all matters appertaining to his particular department. The qualifications for such a post should be, a good technical knowledge, added to a practical experience, not only of molding and core-making in the various classes, but cupola practice and metal mixing; these combined with a sound knowledge of the commercial branch of the business, and a firm, yet kind manner.

The proprietor of the small shop, I am aware, has to be his own manager and foreman, too, but even he can take the principle of the foregoing paragraph and learn his lesson well therefrom. The foreman, while possessing a good practical knowledge and experience in the art of molding should be able to portion out his work to advantage, and have an idea of the value of the core-making and molding of each piece. He should be kept free from account books of any kind, leaving him at liberty to superintend the men and direct the work of the shop. To the foreman we look for the output of castings, and only when some serious increase of expenditure is incurred need we trouble him about the cost accounting.

The clerks or commercial men should be made specialists in their particular line, for there are many things in a foundry with which they must become familiar before any reliance can be placed upon their work. With some firms, too much notice is taken of the officials in the general office respecting the working of the foundry. If these could be persuaded to go into a casting shop when a big job is being poured, they would vote it a filthy place, and not fit for them to be in. On such individuals is sometimes, however, bestowed the important work of making up costs and estimates, and to such, a foreman is expected to bow and scrape his allegiance and pour out his own knowledge and wisdom for the benefit and probable promotion of his hearer, and the possible downfall of himself.

Therefore the office-man for the foundry department should be selected from those who know their own business and the requirements of a foundry. A man who devotes himself to studying his work, who takes a delight in all things appertaining to the foundry, who spares neither time or money to thoroughly master every detail in founding, such a man is a credit to the firm and a source of strength in the upbuilding of a business, for reliance can be placed on his work and methods.

The Keystone Pattern & Foundry Co. have been organized at Evans City, Pa., with a capital of $12,000. Directors, H. J. Ifft, G. G. Lotz, T. M. Maxwell, J. N. Maxwell and W. E. Lloyd.

Among the Foundries.

F. J. Taylor and J. J. Cunningham, who for several years have been connected with the Gurney Foundry Co., of Toronto, Ont., are organizing the Western Stove Co., with a capital of $50,000 to manufacture stoves and ranges. They have purchased the National Iron Works of Wingham, Ont., which will be fitted up to meet their requirements.

The Peru Steel Casting Co., Peru, Ind., are erecting additions to their plant which will materially increase their capacity.

The Commonwealth Steel Co., of Granite City, Ill., recently completed their plant, the buildings of which cover eight acres of ground. Their present capacity is 200 tons of finished castings per day and additional melting furnaces to be installed at an early day will materially increase this. We are advised that they are in a position to guarantee prompt delivery of steel castings.

The Donovan Wire & Iron Works, Toledo, O., have let contracts for a new plant which includes a foundry 60x180 feet, machine shop 60x200 feet and a pattern shop 40x80 feet. Structural iron work will be made a specialty.

The Marion Gray Iron Foundry Co., Marion, Ind., are building an addition 80x122 feet in which will be installed a new cupola and blower.

The Frazer & Jones Co., Syracuse, N. Y., are putting up a new foundry building and also increasing the capacity of their old plant.

The Bellefontaine Foundry & Machine Co., of Bellefontaine, Ohio, have been incorporated with $50,000 capital stock by W. W. Fisher, James M. Elrite, R. F. Tremain, John E. Welsh and Charles Harnell.

The Riverside Boiler Works, of Ridgefield Park, N. J., are adding a foundry 34x84 feet to their plant.

The Racine Steel & Iron Mfg. Co., Racine, Wis., makers of cast and steel wagon skeins, have increased their capital stock from $75,000 to $125,000 to provide for extensions and new equipment. The officers are J. G. Johnson, president; C. W. Hawes, vice president, and G. N. Prentiss, secretary and general manager.

The National Foundry Co., of 32 Sandford street, Brooklyn, are having plans prepared for a large addition to be built to their plant. The main building will be about 200x200 feet. In addition to cast iron pipe the company contemplate the production of machine castings. A trolley system will be a feature of the new quarters.

A crucible steel plant is being installed by the Nortmann & Duffke Foundry Co., Milwaukee, Wis.

The A. & F. Brown Co. of Elizabeth, N. J., are extending their foundry and making alterations which will give them the facilities for increasing their output.

The Philadelphia Stove Co., of Camden, N. J., have been incorporated with a capital stock of $250,000, for the purpose of manufacturing stoves, etc. The incorporators are George H. B. Martin, William F. Erdell and F. H. Hansell.

The Bergan Brass Foundry Co., South Bend, Ind., succeeds to the business of the South Bend Brass & Bronze Co.

The A. Garrison Foundry Co., of Pittsburg, is erecting a new pattern shop and storage house and will shortly begin the building of a new foundry.

The Lane & Bodley Co., Cincinnati, O., builders of Corliss Engines, are planning a new foundry 120 feet wide and of indefinite length. It is intended to fit this up so that jobbing work may also be taken care of.

The Pennsylvania Malleable Co., McKees Rocks, Pa., have decided upon the erection of a car wheel foundry, with a daily output of about 600 wheels. The foundry will be 300 feet long by 120 feet, and additional buildings will contain the power plant and cupolas. Two cupolas will be installed with a melting capacity of 15 tons an hour each. The capacity of the company's malleable plant is also to be increased from 50 to 75 tons daily. An addition is being added to the main foundry building 32x180 feet. The melting capacity is being increased by the erection of an additional open-hearth furnace. C. W. Sherman is general manager and the new construction is being carried out under his direction.

The Gleason, Bailey & Sciple Co., Seneca Falls, N. Y., have been reorganized with a capital stock of $200,000, and the following officers: President, H. M. Sciple; vice president, O. M. Sciple; secretary and treasurer, C. E. Matthews of Huntington, W. Va.; manager, F. C. Beebe. The Gleason & Bailey Co. manufactured pumps and this business was continued after Mr. Sciple purchased it several months ago, but this branch of the business will be practically discontinued by the new company, which will manufacture gasoline engines, cast iron fittings for pipes and other specialties.

The Ridgway Machine Tool Co., of Ridgway, Pa., recently incorporated with a capital of

$300,000 to manufacture lathes, planers and boring mills, will have a plant consisting of the following buildings: Machine shop, 112½x225 feet, erecting shop 75x225 feet, foundry 112½x150 feet, pattern building 75x150 feet, heating room 37½x37½ feet, power house 37½x75 feet, all of the buildings to be of brick and steel construction.

The Gadsden Car, Foundry & Machine Co., Gadsden, Ala., have purchased the plant of J. R. Proctor, and will remove it to their present location. The company makes a specialty of mining and logging cars.

The Zanesville Malleable Iron Co., Zanesville, Ohio, have nearly completed their new plant which will employ about 120 molders when running to its full capacity.

The Schwab Safe & Mfg. Co., of Fostoria, Ohio, have changed their name to the Atlas Safe Co. E. W. Ervin is president of the company, Mr. Schwab having sold out some time ago, to engage in similar business in Toledo.

The Johnston & Jennings Co., of Chicago, have let a contract for a foundry, 90x162 feet, to cost $20,000.

G. W. Struckman has purchased the Celina Machine Works, Celina, Ohio.

The Gray Iron Casting Co., has been organized at New Castle, Ind., by J. F. Thompson, G. W. Hillock and C. M. Pitman.

Thos. Bailey & Co. and the Athens Foundry & Machine Co., Athens, Ga., have consolidated their interests, under the management of Thomas Bailey.

The Deering Plant of the International Harvester Co. are building a foundry, 80x830 feet, and a five-story manufacturing building, 70 x252 feet, at their works on Fullerton avenue, Chicago. The improvements have been made necessary by the increased volume of business.

W. D. Williams, Fredericksburg, Va., will rebuild the foundry and machine shop, destroyed by fire sometime ago.

The Medina Foundry Co. have been organized at Medina, N. Y., with a capital of $30,000, by Michael Slack, O. F. Butts and B. E. Slack. The new concern succeeds to the business of Butts & Slack.

The Burlington Brass Works, Burlington, Wis., have been organized with the following officers: G. C. Rasch, president; O. O. Storle, vice president; John P. Gill, secretary and treasurer. Five acres of ground have been purchased and work will be begun at once on a foundry and machine shop.

H. W. Harman has purchased the foundry at Freeburg, Pa., formerly operated by Henry C. Fisher.

The Coxey Steel Casting Co., of Mt. Vernon, Ohio, and the Coxey Silica Sand Co., of Massillon, Ohio, both owned by J. S. Coxey, of Commonweal Army fame, have been placed in the hands of James Israel, as receiver of both properties. General Coxey has expended nearly $300,000 on the steel plant at Mt. Vernon, but has never been able to complete it.

J. & E. Brown will establish a foundry at Portage la Prairie, Manitoba. A building 40x120 feet is now under construction.

The Stowell Mfg. & Foundry Co., South Milwaukee, Wis., have increased their capital stock to $200,000.

The Ensign Foundry Co. have been organized at Toledo, Ohio, with a capital stock of $10,000. Frank H. Ensign, John Stollberg, C. W. Rushing, D. R. McChesney and Lawrence Raab are the incorporators.

The American Anchor & Foundry Co. have been incorporated to do business at Lima, O., by Jesse L. Smith, H. S. Moulton, T. A. Robinson, W. H. Woolery and O. F. Ramseyer. The capital stock is $10,000.

An addition is being built to the foundry of the Johnston Harvester Co., Batavia, N. Y.

The North Wales Foundry Co., North Wales, Pa., are extending their foundry.

The New York Air Brake Co., of Watertown, N. Y., have purchased additional ground upon which it is reported that a large foundry will be built.

R. H. Crowgey has purchased a half-interest in the Wytheville Foundry & Machine Works, Wytheville, Va., and will, with John B. Hurt, put the plant in operation.

It is announced that the Ross-Meehan Foundry Co., of Chattanooga, Tenn., will add a department for the manufacture of bells to their establishment.

The Universal Iron Foundry is incorporated at Brooklyn, N. Y., with a capital of $35,000. Philip Schwickart, C. B. Nagel and Herman Schwickart are named as directors.

The Utica Pipe & Foundry Co., Utica, N. Y., will build an addition, 60x150 feet, to their foundry. The new department will be devoted to turning out small castings for steam specialties.

The Detroit Steel Casting Co. is constructing an addition, 75x150 feet, at an estimated cost of $10,000.

The Allis-Chalmers Co.'s lease of the Lake Erie Engineering Works at Buffalo, N. Y., having expired the operations there carried on

have been transferred to the new shops at West Allis, Wis. It is expected that a new concern will operate the Buffalo plant.

The Poughkeepsie Foundry & Machine Co., Poughkeepsie, N. Y., who have occupied their present factory site since 1831, have purchased ground in a new location on which they will erect a modern foundry, for which plans are now being prepared.

A new foundry is being built by the Wolverine Brass Works, Grand Rapids, Mich.

The Jeanesville Iron Works, Jeanesville, Pa., will erect a large plant at Hazleton, Pa. According to the plans prepared the main building is to be 106x538 feet. The foundry will contain three cupolas.

A $75,000 foundry is to be built in Chicago by the Otis Elevator Co.

The Thomas Mfg. Co., of Springfield, Ohio, are contemplating the erection of a new foundry, as the capacity of their present shop is too small to meet their requirements and a large part of their castings have to be made by outside concerns.

The Walburn-Swenson Co., Chicago Heights, Ill., have changed their name to the American Foundry & Machine Co.

The plant of the Hoosier Foundry & Machine Works, at Columbia City, Ind., has been leased by J. F. Lawrence to the American Butter Separator Co., who will manufacture a patent churn.

An addition 20x140 feet is being made to the foundry of the Eynon-Evans Mfg. Co., Philadelphia.

The announcement comes from Birmingham, Ala., that Frederick Dimmick, president of the Dimmick Pipe Co., has purchased the property of the Williamson Iron Co., which, besides a foundry and machine shop, also includes a blast furnace having a capacity of 75 tons of iron per day.

Personal.

Robt. J. Scott, recently superintendent of the Allegheny Foundry Co., Warren, Pa., has accepted a position with the Ridgway Machine Tool Co., Ridgway, Pa.

W. W. Shaffer has been placed in charge of the foundry department of the Larzelere Machine Co., Williamsport, Pa.

Michael Congdon succeeds Adin Willis as general foreman of the Sterlingworth Railway Supply Co.'s foundry, Easton, Pa.

Thomas Robertson, for many years foreman with the Atlas Engine Works, Indianapolis, Ind., has accepted the position of superintendent with the Goulds Mfg. Co., Seneca Falls, N. Y.

Deaths.

George Alfred Bell, treasurer of the Marion Malleable Iron Works, Marion, Ind., died very suddenly at his office on Tuesday afternoon, August 26. He had been in usual health up to the day of his death. The deceased was born at Brooklyn, N. Y., September 6, 1851. He was educated in the public schools of Brooklyn and at the Brooklyn Polytechnic Institute. After graduation at the latter he spent some time in Europe and subsequently entered the employment of the Pratt Oil Works and was with this concern at the time of its absorption by the Standard Oil Co. With the Standard Oil Co. he held various positions of trust and in 1886 severed his connection with the company to become auditor of the Troy Steel & Iron Co., at Troy, N. Y. He was successively auditor, general superintendent and general manager of the Troy Steel & Iron Co. and upon the organization of the Troy Steel Co. became vice president and general manager of the new concern which position he held until August, 1900. His connection with the malleable business dates from that time. During his connection with the steel works at Troy, Mr. Bell became an expert metallurgist and had few peers in this line.

James Duffy, the veteran foundryman of Hannibal, Mo., and founder of the Duffy-Trowbridge Stove Mfg. Co., died recently.

Fires.

A fire at the plant of the Lorain Foundry Co., Lorain, O., September 8, destroyed a large frame addition and did some damage to the roof of the main building. There will be but little interference with the regular business of the company and repairs will be made immediately.

The plant of the Mt. Pleasant Foundry & Plow Co., Mt. Pleasant, Mich., burned September 8.

The works of the Kokomo Brass & Iron Co., Kokomo, Ind., were partially destroyed by fire September 10. The loss is covered by insurance.

The Hartford Foundry Co.'s plant at Hartford, Conn., was gutted in a recent fire and considerable loss sustained in damage to patterns and other property. The works will be rebuilt as early as possible and arrangements

made to take care of the concern's customers.

McFarlane & Co.'s foundry at Denver, Colo., burned September 5, entailing a loss estimated at $10,000.

Considerable damage was done to the foundry of Marsh & Henthorn, Belleville, Ont., by a recent fire, which also destroyed a number of patterns.

The Fitzgerald Iron Works, Fitzgerald, Ga., burned recently. The shops will be rebuilt immediately.

The plant of the Huntington Stove & Foundry Co., Huntington, W. Va., was destroyed by fire August 28.

The Foundry Carpenter.

An important person at times around the foundry is the carpenter of the shop, who has received little or no mention in these columns. Didn't you ever tantalize him while he was working like a beaver putting in cross bars or cutting out others? Of course you did. I have in mind a member of this fraternity who has his shop fenced off in one corner of the dog house, and all the jokers who work for the company are to be found right in this part of the works, and needless to say this carpenter, who happens to be an old German, has a great time with the gang.

At seven in the morning he will take his position at the bench, facing the audience with his hands resting on his hips and a kind of an out-all-night smile on his face, never saying a word while the gang is teasing him. He will stand in this position until about eight o'clock (unless the boss should happen to see him sooner), then he will begin to saw wedges and if any of the molders take the liberty to go over and pick up a few he will growl about the extravagance of molders and helpers. Sawing wedges is about all he does day after day, since most of the flasks employed in the shop are iron ones. About 11 o'clock he will start to wash up and make his toilet for dinner; if a wooden flask needs to have a bar put in he will growl and roll up his sleeves, at the same time relating how he had fixed that same flask once before, about four years ago.

He always ceases work when the blast goes on and will skim when the iron is down. If the molders are late he will go home when the whistle blows (he is a carpenter then), but if all hands are through before the regular time he will go home with the molders. If you should want a bar cut out he will tell you to come and get a hatchet and do it yourself, that he is busy just then, perhaps filling his pipe.

I know of another carpenter in a different shop, a typical Yankee by the way, who is a hard worker and as nimble as a fox, although an old man. He is always taking some kind of medicine, patronizing every new nostrum which is advertised on the bill boards across the street. He has a large medicine chest in the shop and if anyone complains to him, he always has a remedy which will cure the afflicted one. The roof of this foundry is in bad shape and he is spending a good deal of his time patching it. We have been in the habit of telling him that every time he fixes it it leaks better. One day he was called to fix something on top of a small jib crane, and instead of climbing up the usual way he put a ladder against it away out near the far end of the jib, and when he got about two-thirds of the way up the crane swung around before he could dismount, and down he came. Two men helped him hobble to his medicine chest, where he used his supply of arnica, and he has since then been in the habit of using a walking cane.

C. A. NADA.

Recent Patents.

John J. Carroll has secured patents Nos. 691,442 and 694,315, which he has assigned to the National Malleable Castings Co., of Cleveland, Ohio. The first embodies a novel device for marking castings so that they will show the heat from which they were made and the system may also be made to include the date and other matters of which it is desired to have the casting itself furnish a record. The object sought is a method whereby the marking may be done at will and any changes made in same at any time prior to the pouring of the mold. A core or a chill having a standard opening for the reception of the type or marking device is placed on the pattern and rammed up in the mold and furnishes a means by which the type itself may be inserted any time. The core or chill composing the type may also be inserted at the time of making the mold and changes made if found necessary later on. It is, of course, understood that the type, and the cores which furnishes a print for same, come flush with the face of the mold. The other patent of Mr. Carroll's relates to a riser of special construction. It is made in a dry sand core and in ramming up the cope it is placed on the desired part of the pattern where a shrinkage of metal is likely to occur. The core is so made that the upper part of the riser is closed, with the exception of a small vent

hole. The idea of Mr. Carroll's seemingly being to obtain all the benefits which a supply of metal on such part of castings can give without extending this through the full length of the cope. Both of these devices are illustrated as being applied to the casting of draw bars.

C. W. Sevalley, of Milwaukee, has patented a method of casting the teeth of sprocket wheels in chills. Ordinary patterns are employed with a separate chill for each tooth and whatever is the pitch and the number of the teeth the same chill can be used so long as the teeth are of the same size and shape.

Daniel B. Lincoln, of Wollaston, Mass., has been granted patent No. 688,023 on a bottom board for flasks, which comprises a plate of sheet metal and a number of flanges attached thereto.

The invention of Morgan A. Perrigo, of Wilkesbarre, Pa., patent No. 691,174, was alluded to in the April issue of THE FOUNDRY. He claims, "The process for producing axle-boxes having hardened interior faces, which consists in first mixing pulverized sulphur and sand in the proper proportion; next reducing the resulting material to the proper consistency by the addition of a liquid binder; next, forming a core from the resulting mass; finally, casting the box around and in contact with said core." The idea of using sulphur to harden the face of a casting was suggested several years ago by Mr. L. C. Jewett. He applied it to the casting of gear teeth. The inventor does not mention the fact that this process would tend to make the castings brittle.

Attempts to secure an indestructible mold composed of materials which will not injuriously affect cast iron have been made for many years. Along with this class of inventions must be placed the patent for a permanent mold, granted to Ssemon Michailoff, of Odessa, Russia, No. 694,566.

He uses a perforated two-part flask provided with a number of bars extending lengthwise of it, each one having a series of pins bent at the ends and extending inwardly to hold the first layer of molding material. The rough mold is made in the ordinary manner by applying the material in one, two, or more layers, each layer being dried before the other is applied. When two layers are used, the following method is preferred: a mixture of loam clay and fine-chopped straw is stirred with water to form a stiff paste and is spread in a suitable thickness over the walls of the flask and is then dried. A second layer of approximately the same thickness is then applied so as to substantially cover the remaining portions of the right-angled metallic hooks, rigidly secured to the flask, consisting of refractory clay, sand and horse-manure taken in about equal proportions, ground and mixed with water and boiled oil to form a plastic mass. After drying by hot air or furnace gases this layer is covered by a thin one (3 or 4 millimeters) of a sticky paste material which forms after drying a crust as hard as stone and adheres firmly to the material of the rough mold, but does not adhere to the molten or solidifying metal. Owing to these properties, the inmost layer of the mold is extraordinarily durable in spite of its very slight thickness, and a mold is produced which can be used many times with very slight repairs of this inmost layer by applying to the injured parts some fresh material, which gets dry at once by the heat of the mold. The material for this inmost layer is prepared by grinding and mixing about 40 per cent of burnt refractory clay (terra-cotta powder), 15 per cent of burnt crucible graphite, 10 per cent of fatty clay, 15 per cent of washed sand (river sand), 5 per cent of charcoal and 15 per cent of cow-dung, with water and boiled oil taken in the proportion of about 3 to 1 and in such quantity as will be necessary to produce a sticky, pappy material. In order to finish the mold, there remains only to dry or fire the same by means of furnace gases, hot air, or the like, and to paint or dust the surface of the finished mold with a coat of graphite in the usual manner.

If the mold is to be composed of two or more parts the joints are closed, so as to obviate the forming of casting-seams by means of the fresh (not dried) material of the inmost thin layer that fills the small trapezium-shaped or dovetailed grooves left along the inner edge of one of the surfaces of the parts of the mold at the joints, so that when these surfaces strike together the excess of filling material is squeezed out of the grooves in the mold, and a perfect joint is obtained. These grooves are made while the material is plastic by making a depression along the edge with a trowel or board.

We have described this patent simply as a matter of news. When it comes to the manufacture of water and gas pipes, it is a question if it would not take longer to repair a mold, as suggested by Mr. Michailoff, than it now takes our foundries to make a complete mold for each casting.

Another patent relating to the molding of gas and water pipe, and evidently having for its object to do away with the hay rope now employed in making the cores for this class of castings, is No. 695,730, granted to Frank Jones and Chas. J. Pennell, of Massillon, O., on a composition for pipe cores and like castings. For the smaller sizes of pipe the composition consists, preferably of 25 per cent peat or vegetable soil, 50 per cent clay, 20 per cent straw, 1 per cent soda-ash, 3 per cent lime. This mixture is applied to the core bar, and when it is removed from the oven a coat of loam and pipe blacking is applied, and after again being dried the core is then ready for use. For making heavy castings, the straw and tar may be omitted, and then the composition consists of 74 per cent peat or vegetable soil, 24 per cent clay, 1 per cent soda ash, 1 per cent lime. This mixture is applied to the core bar and immediately over it is applied a coat of loam, which in turn is coated with pipe blacking and dried.

Patent No. 696,035 covers a process of making metallic matches for patterns, instead of the ordinary sand match now employed, and is granted to John Gilson, of Port Washington, Wis. The inventor claims that the latter is unsatisfactory in that it does not retain sharp edges and is liable to be damaged and permanently injured. All of which may be very true, but we are rather of the opinion that where castings from a pattern are wanted in sufficient quantities to require a metallic match that the same could be placed on a molding machine to still better advantage.

Geo. W. Packer, the inventor, has assigned his patent, No. 686,123, to the Deering Harvester Co., of Chicago. This covers a system of endless conveyors for delivering castings to tumbling barrels, and an arrangement for raising and discharging the annealing pots used in the manufacture of malleable iron castings.

Wm. R. Clark, Harvey Bosworth and Wm. G. Bosworth have designed molds for casting journal bearings, on which they have been granted patents Nos. 695,090 and 695,091. These are metal molds made up of top and bottom sections, hinged together, and easily removable side sections. The top and bottom sections are provided with removable back and front plates, which are formed of anti-friction material. That section of the mold carrying the gate is separable from the main part and is lined with graphite. Provisions have been made whereby the mold may be adjusted to castings of different dimensions.

Alfred E. Hammer, of Branford, Conn., has designed several forms of rammers to be used in connection with machines making cores for pipe fittings. The object sought is to ram the sand into out-of-the-way portions of the core box. A. E. F.

Chemistry and Cupola Practice.

That practical chemistry is of value to the founder has been fully demonstrated in many foundries, and that the value of chemistry to the founder may be destroyed by bad cupola practice has also been fully shown. Scarcely a week goes by that we do not learn of trouble with iron due entirely to bad melting. Only last week I was called upon to visit a foundry that had been in operation for 19 years to see what was wrong with their cupola, from which they could not obtain hot iron.

Upon investigation, I found that the iron was not only not sufficiently hot to run light work, but was dirty in heavy castings with shrinkholes in hubs or other heavy parts of castings. These shrinkholes and dirt entirely disappeared when the iron was properly melted; which showed they were not due to the quality of iron, but to the way in which it was melted.

Of what value would chemistry have been in this case? Of none at all, for the elements or metalloids that caused these shrinkholes were not in the iron before it was melted nor when it was properly melted, and the cause of them could not therefore be determined by chemistry in time to prevent them occurring in the casting, and if determined after the casting was made and a change made in mixture to prevent their re-occurrence they might again be caused by another form of bad melting. In this way a practical melter can destroy the results of any chemist's work almost every heat and a poor melter may destroy them without knowing he is doing so.

The only way the chemist can expect to overcome this difficulty and be certain of results is to become a practical melter. This he may readily do from a little practical instruction after learning the theory of melting in a cupola.

To be a practical melter it is not necessary that a man should be a pattern maker, green or dry sand molder, core maker, expert on molding sand, facings, etc., or that he should know all about calorimeters, pyrometers, degrees of heat in a cupola, temperature at which iron should be melted, poured, etc., etc.

Scarcely one practical melter in a hundred knows anything about these things more than he may observe by daily contact with them in the foundry. As for degrees of heat no instrument has yet been designed that correctly or approximately indicates degrees of heat in a cupola or blast furnace. The pyrometers used by blast furnacemen are only for indicating temperature of blast, and it is doubtful if any other temperature can ever be obtained for the peculiar construction and workings of cupolas and furnaces preclude the possibility of applying any temperature instrument to them at the melting zone.

The melting of iron in a cupola, while by no means a trifling matter as some founders profess to believe, is an art that may be readily learned when the theory of melting is once fully understood. This theory is based upon the space occupied by fuel and iron in a cupola and not upon the heat producing units of fuel consumed in melting as is only too often the case.

When a few small shovels of fuel are consumed in a heating stove only a limited amount of heat is produced and it is only when the stove is filled with fuel that its full heating capacity is realized. For the greater the amount of fuel consumed the greater the heat produced.

But this is not the case in a cupola, and we get no higher degree of heat by filling the cupola to the charging door, with fuel than we do by filling it to only 15 to 30 inches above the tuyeres. Not a pound of iron can be melted on fuel at the charging door, or at any point within many feet of it in a cupola of a proper height, no matter how great the amount of fuel consumed. This we have proven by fastening bars of iron in the lining, from the bottom to the charging door, so they could not settle with the fuel as this burned away, and filling the cupola with fuel to the door, before putting on the blast for melting, and burning up all the fuel with a blast sufficient to melt iron before dropping the bottom. In these experiments it was clearly proven that iron can only be melted within a limited space in a cupola which is designated the melting zone, and therefore a cupola is a space furnace.

The space or zone in which iron may be melted is from 10 to 14 inches in depth and it cannot be melted at all above or below this zone and the space in which it may be melted properly is from 6 to 8 inches. The point at which this zone is located in a cupola varies with the kind of fuel used and volume of blast.

With coal it is 6 to 14 inches above top of tuyeres and with coke 12 to 20 inches, and may be raised a few inches by a large volume of blast and lowered a few by a small volume But 14 inches with coal and 20 with coke will generally be found to be about a proper height for a bed, which represents the top of melting zone.

The top of bed is lowered from 6 to 8 inches in melting iron placed upon it, and only the weight of iron that can be melted by lowering the top of bed to this extent should be placed upon it. The next charge of fuel should only be sufficient to replenish the bed and raise the top of it to its original height when melting began.

The iron placed upon this fuel should only be the amount that can be melted in consuming it, and each charge of fuel and iron should be of such proportions that when the charge of iron is melted, the charge of fuel will only be sufficient to raise the top of bed to the same height it was when melting began.

When a bed is of a proper height to begin with and this rule of charging is closely followed and the cupola slagged, melting may be continued as long as a lining lasts, and hot iron of an even temperature produced throughout the heat.

But when a bed is not of a proper height, or the charges of fuel and iron are not of correct proportions, even a small heat cannot be melted without change in temperature of iron which may be sufficient to necessitate dropping the bottom.

The most important point in melting is to have a bed of proper height to begin with, for if we do not have this there can be no accurate system of charging. The construction of cupolas and volume of blast supplied to them vary to so great an extent, that no exact measurement can be given for a bed that will hold good in all cupolas, but 12 inches with coal and 20 with coke above top of tuyeres will generally be found to be about the correct measurement for a single tuyere cupola. For double tuyere cupolas the second row of which, as now constructed are of such a variety of areas that not even an approximate measurement for bed can be given that will hold good in all cupolas.

In determining the height of a bed I have found it a good plan to begin with a presumably high bed and 3 pounds of iron

on bed to 1 pound of fuel and 10 pounds of iron to 1 of fuel in charges, and to gradually reduce the bed each heat until a hot even iron is obtained throughout the heat.

The one point to guard against in melting is too much fuel in the cupola; for as dull iron may be made with too great an amount of fuel as with too little, and is more often the cause of dull iron than too little fuel.

Melters, when iron comes dull, are apt to remember that cold day last winter when they filled up the stove to make a warm room and to apply the same remedy to the cupola when iron comes dull and as a result 90 per cent of melters place too large an amount of fuel in their cupolas to do fast melting or make hot fluid iron. EDWARD KIRK.

New Methods of Molding.

During the first meeting of the American Foundrymen's Association, at Philadelphia in 1896, I heard a great deal about the new method of molding adopted by the late Mr. Garrett, at that time foreman of the Westinghouse Machine Co.'s foundry, at Pittsburg. On coming west, I stopped off at this city for a month or so and had ample time to investigate everything connected with this. I met Mr. Garrett, who took me around the foundry and machine shop, in the latter of which there were upwards of 200 Westinghouse engine bases with cylinders, which there is no need to describe, as their form is well known to nearly everyone in the trade. However, I should say that they were a creditable lot of castings. It is a well known fact that when a craftsman is inspecting some work done by another in the same trade that this is done with a critical eye, and I must own up to the fact that I only found two small blemishes on this whole lot of castings.

In describing his method of molding these engine bases Mr. Garrett explained that they were made the same as any other green sand mold with the exception that the flask is so made that all sides may be opened out. The flask proper consists of six pieces, the bottom part or drag, and the four hinged sides, which forms the cheek, and the cope. At that time, after the mold was opened up and finished it was gone over with molasses water and left to dry through exposure to the atmosphere. The only drawback I could observe to this system was that they needed a much larger space to work in, as the mold would ordinarily take two or three days to become dry enough to cast, so a comparatively large space would be required to turn out relatively few castings. But the idea is all right if one has room to spare.

Later on when I went out to Arizona to take charge of a foundry in that territory I had a good chance to test this, although it was rather compulsory on my part to do so, as no sand was obtainable there suitable for heavy castings, without drying the mold, so I put wet blacking on the greater part of the molds, left the doors open, and in that climate the mold soon dries and the casting will come out all right even if the sand is not exactly what it should be. It would be interesting to know if other foundrymen ever tried the same method of turning out work and the time it takes them to do so. There are any amount of molders throughout the country who could give us some good ideas about different ways of doing foundry work, and in my time I have spoken to quite a few of these but they all appear rather shy and are afraid of being laughed at by telling what they know. For my part I am willing to own up to the fact that I am looking for information. In following the method here described the molds must be made in iron flasks, as if wooden ones are employed the molds will all crack. THOMAS WATHEY.

Specifications for Cast Iron Pipe.

Walter Wood, of R. D. Wood & Co., Philadelphia, recently stated that one of the annoyances to which the pipe founding industry was subjected was the appointment of politicians to act as inspectors of cast iron pipe. He urged that the variations in weight be kept within reasonable limits, or about 2 per cent on the whole contract, while the weight of individual pieces may be 2½ or even 5 per cent. The practice in testing cast iron pipe has changed from the use of a 1-inch round bar with 16,000 pounds tensile strength to a drop test on a 2x1-inch bar, on supports 24 inches apart, to sustain a breaking load of 1,800 to 2,000 pounds. It is also the custom to subject pipe to a hydraulic test, which is not really a test of the casting for strength, but is intended to develop defective pipe. The pressure of 300 pounds per square inch does not approach the destruction limit, and it is seldom that a good casting is broken under the hydraulic test. The formula for the coating of cast iron pipe was first specified by Dr. Angus Smith, of Glasgow, a name which still persists in specifications, although it is no

longer used. There is now adopted generally a mixture of a distillate of coal tar and oil, the latter to keep the same elastic, applied at a temperature of 300 degrees. Iron most suitable for cast iron pipe should range in phosphorus from .5 to 1 per cent; manganese about the same range, though .75 to 1 per cent is more desirable; silicon, from 1.25 per cent for large pipe and 2.25 for lighter pipe. Sulphur should be very low.

Notes from Various Sources.

G. H. Clamer, of the Ajax Metal Co., Philadelphia, has been granted a patent for an improved method of eliminating metals from alloys, which is partly explained by the following quotations from the patent:

"For the sake of a further description of the invention it will be assumed that the scrap or alloy contains copper, tin and zinc, which is a common form of scrap, and further, that it is desirable to eliminate the zinc from it and to replace the zinc in it by lead, which would result in alloy containing copper, tin and lead. This last alloy, which contains lead, is useful in the manufacture of railway bearings and other articles, whereas the alloy which contained zinc would not be useful for such purposes. The substitution of lead for zinc above referred to can be effected in accordance with my invention in the following manner: The alloy of copper, tin and zinc is heated in contact with oxide of lead, which is held in solution by a suitable flux, as silica and lime or silica and soda ash. The heat of formation of the lead compound is less than that of zinc, or, in other words, lead is electro-negative in respect to zinc. The result of this is that the zinc replaces the lead, forming oxide of zinc, which remains in the slag and the lead which is reduced from the oxide is taken up by the copper and tin and becomes a part of the new alloy. The proportions in which the oxide of lead is used is determined by reference to its valency. From the foregoing example it is apparent that to eliminate a metal from an alloy or from scrap and replace it by another metal it is necessary that the scrap or alloy should be melted along with a suitable flux containing, also melted, an oxide, sulphide, or chloride or equivalent, of a metal which is electro-negative in respect to or the heat of formation of which is less than the metal which is to be eliminated. In all cases the well-known law of valency controls the proportions. By using sufficient of the electro-negative metallic compound to satisfy the valency of the most electro-positive metal or metals of the alloy it is possible to eliminate one or more of them, as desired."

The Field-Croxton Iron Co., have been formed at Cincinnati, O., to deal in pig iron and foundry coke. H. A. Croxton is president of the new concern, William Wieman, vice president, and Robert Field, treasurer and secretary.

The scarcity of coke calls attention to the Connellsville region and the enormous production of that district, which requires an immense number of cars and locomotives for its distribution. To move 250,000 tons of coke—the average product per week for several weeks—requires about 12,000 cars, about 300 trains of forty cars each, or one solid train almost 73 miles long, to haul which about 600 of the Pennsylvania Railroad's largest engines would have to be pressed into service. The Frick Coke Co. controls about three-fourths of the plants of the region and has in its employ about 15,000 men, who are now receiving higher wages than ever before known.

E. J. Woodison, manager of the Detroit office of the S. Obermayer Co., issues "Obermayer's Bulletin," which is intended to be a medium in which questions relating to foundry practice may be asked and answered.

The Pittsburg Stove & Range Co., which was formed a few years ago by the consolidation of a number of stove foundries in the Pittsburg district, have entered suit against Lyman De Haven, A. C. De Haven and John A. Roe, acting as the Pennsylvania Stove Co., with a plant at Ellwood City, Pa., to restrain them from manufacturing stoves for five years from September 1, 1899. It is claimed that in selling their good will they agreed to remain out of the stove business in Ohio, Pennsylvania and West Virginia for five years.

The Northern Electrical Mfg. Co., of Madison, Wis., have issued Bulletin No. 29, showing illustrations of their motors applied to various forms of machinery, among which we note pressure blowers, tumbling barrels, cranes and emery grinders.

Dr. Richard Moldenke, secretary of the American Foundrymen's Association, has issued, as a souvenir, a cloth bound volume containing the proceedings of the Boston Convention and illustrations of incidents occurring at that time.

The Port Huron Air Tool Co., Port Huron, Mich., are mailing a booklet describing their pneumatic hoists and air tools. They will make a specialty of designing air appliances to meet special requirements.